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WATER QUALITY INVENTORY AND MANAGEMENT PLAN

FLATHEAD RIVER BASIN
MONTANA

STATE DOCUMENTS
JUL 15 '77

by

WATER QUALITY BUREAU
ENVIRONMENTAL SCIENCES DIVISION
Montana Department of Health and Environmental Sciences

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FINAL REPORT
WATER QUALITY INVENTORY AND MANAGEMENT PLAN
FLATHEAD DRAINAGE BASIN, MONTANA

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WATER QUALITY INVENTORY AND MANAGEMENT PLAN
UPPER FLATHEAD RIVER BASIN, MONTANA

I. INTRODUCTION

This report presents information relative to water quality and water quality management in the Upper Flathead River basin (Figure 1). This is one of sixteen basins designated by the state of Montana for preparation of water quality management plans. The Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) have directed states to prepare such plans as part of a nation-wide program for controlling water pollution. The objectives of this effort are to provide the state with water quality data and related information to (1) determine the water quality characteristics of all natural and wastewaters, (2) determine what factors, both natural and manmade, affect the quality of waters, (3) develop a management strategy for maintaining and enhancing the quality of waters in the Upper Flathead River basin, and (4) provide information needed to determine whether Montana's water quality standards are and will continue to be met. Also, included is a description of physical characteristics of the basin. The general methodology used in this study was the compilation and evaluation of existing water quality data and related information. Where information was deficient, field investigations and water and wastewater sampling and analysis were completed to obtain the needed information.

This investigation does not present a detailed analysis of the area's resources, but summarizes water quality related information. As additional information becomes available, the Upper Flathead River Basin Water Quality Management Plan will be revised and updated as part of Montana's Continuing Planning Process.

Assistance in obtaining information for this report was obtained from a number of agencies and persons. The Montana Department of Natural Resources provided information on land use, water use, economy and population.

II. SUMMARY AND CONCLUSIONS

There are 7 municipal, 8 agricultural and 2 industrial discharges in the Upper Flathead drainage basin. Permits have been issued under the joint state-federal discharge permit system for all 17 of these discharges. Permits for several other potential agricultural discharges are pending. Compliance schedules have been established for three municipal and one industrial discharges. Best practicable treatment is required of industrial dischargers and secondary treatment is required of municipal dischargers, by July 1, 1977.

With the application of best practicable and secondary treatment to industrial and municipal discharges, respectively, it is expected that all waters in the Upper Flathead drainage basin will meet water quality standards, with the possible exception of Flathead Lake. One statement in the water quality standards reads as follows:

> "State surface waters are to be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will....create conditions which will produce undesirable aquatic life."

It has been demonstrated that algal growths are approaching nuisance conditions in parts of Flathead Lake, and that these growths are resulting from discharges of phosphates to the Flathead drainage. A phosphate analysis attempted in this report indicates that only about 3.7% of these phosphates result from municipal or industrial discharges, the remainder resulting from non-point activities. More refined nutrient analyses are needed to isolate these non-point sources, but it appears that over half the phosphates are originating in the lower valley between Columbia Falls and Flathead Lake. The designation of a water quality limited segment will remain for Flathead Lake.

Municipal facilities investments needed to maintain secondary levels of treatment for existing public sewage facilities in the basin are estimated at approximately $3,800,000. In addition, several small unsewered communities have expressed interest in constructing new sewage collection and treatment facilities, although cost estimates are generally lacking at this time. Two communities are presently in the planning stages prior to upgrading their sewage systems to secondary treatment.

A surveillance plan for continued monitoring of water quality in the Upper Flathead basin is described in this plan.

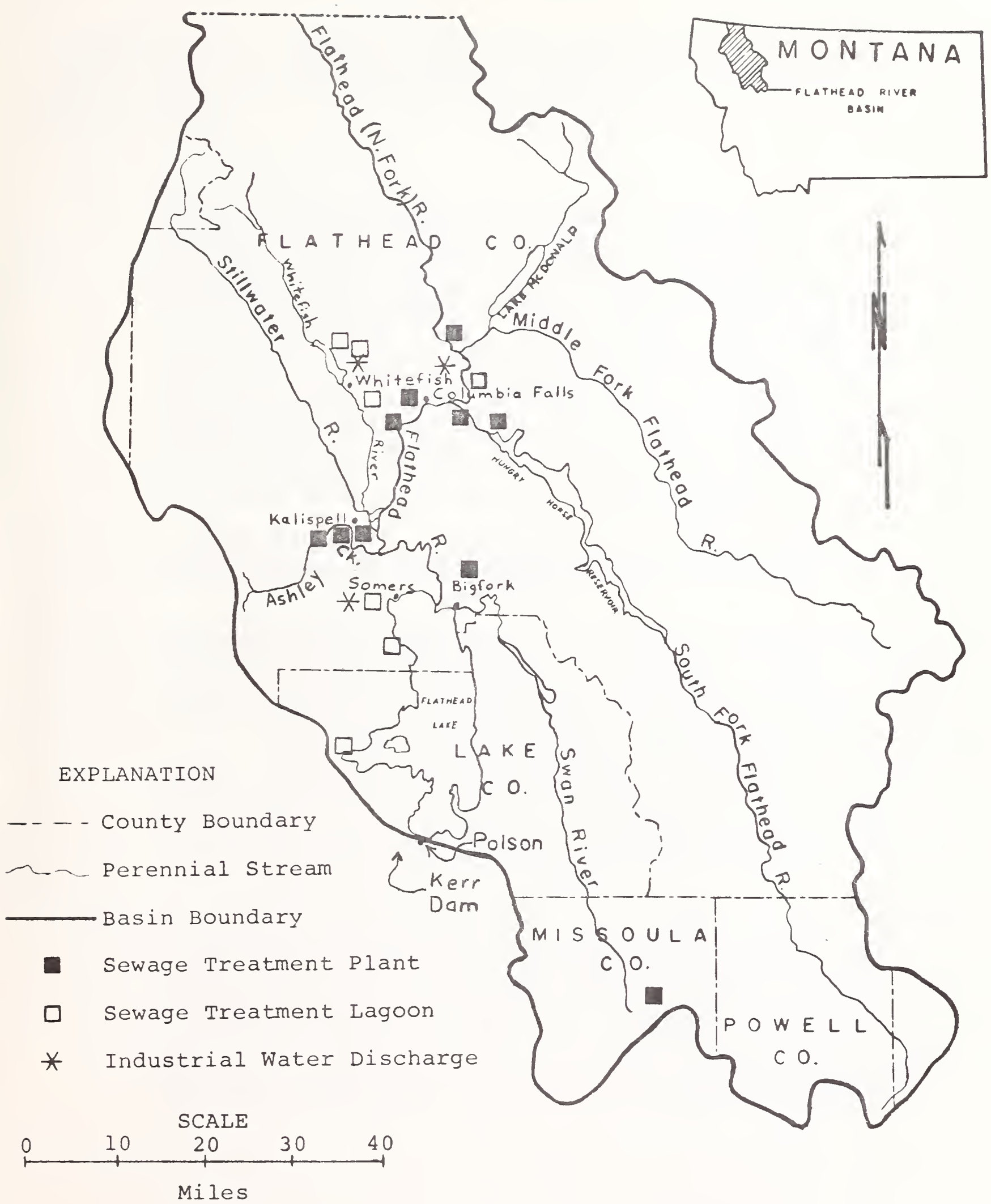


Figure 1. Sketch Map Showing Flathead River Basin

III. RELATED INVESTIGATIONS AND PLANS

The following is a listing of plans, investigations, reports and programs, either completed, under way, or proposed for the near future, which relate to water quality or provide pertinent information within the Flathead drainage basin.

Technical Information Sources

(a) Reports Related To Sewage-The following documents have been prepared relative to sewage treatment: "Interim Project Plan for the City of Kalispell, Montana" prepared by Montana Department of Health & Environmental Sciences, December, 1971, to fulfill the requirements of the Kalispell municipal sewage grant application. "Master Sewage Plan for the Lake McDonald Region, Glacier National Park, Montana" December, 1971, a master sewage plan prepared by Glacier National Park for the west side of the Park area. In addition to these plans, engineering reports have been written relative to specific sewage treatment and collection facilities for nearly all of the sewage plants in the basin. Engineering reports of this type normally are accompanied by detailed plans and specifications. A listing of the basin's sewage plants is given in Section VI of this report.

In addition, Section 201 Facility Plans are now required before federal funding of sewage treatment projects. The facility plans are discussed later in this chapter.

(b) Water Resources Information-Several publications address the subject of water resources in the Flathead drainage basin. Water resources surveys have been published by the state engineers office in Helena, for Lake County and for Flathead and Lincoln Counties, Montana (Ref. 14,15). In addition, the Montana Water Resources Board has published a set of maps for the state of Montana titled "An Atlas of Water Resources in Montana by Hydrologic Basins". Other water resources publications include "Bulletin 53, Montana Bureau of Mines and Geology, Basin Water Data Report #3, Kalispell Valley, Montana" and Bulletin 68, July 1968, Geology and Groundwater Resources of the Kalispell Valley, Northwestern Montana."

(c) Soils, Geology and Minerals-The subject of soils, geology and minerals is addressed in several reports including the following: "Soils Survey, Upper Flathead Valley Area, Montana "(Ref. 35). Also, "Engineering Properties and Soil Interpretation for Use in Resource Planning and Development" (Ref. 36). The subject of geology is addressed in "Geology and Mineral Deposits of Lincoln and Flathead Counties, Montana," (Ref. 33). Other publications relating to oil, gas and coal exploration in the North Fork Flathead drainage are detailed in Section VI, under "Mining Activity".

(d) Floodplain Studies-In 1969, the Corps of Engineers prepared "Floodplain Information, Flathead, Stillwater and Whitefish Rivers, Kalispell-Columbia Falls, Montana". The floodplain information contained in this publication has been updated several times since this 1969 publication, and current floodplain maps are available through the Flathead County Areawide Planning Office.

(e) Wilderness and Wild and Scenic Rivers Reports-The following publications, all prepared by the U.S. Forest Service, are available relative to Wild and Scenic and Wilderness Study areas: "Wild and Scenic River Study Report, Flathead River, Flathead National Forest, November 1, 1972". "New Wilderness Study Areas, Roadless Area Reivew and Evaluation, October, 1973".

(f) Land Use and Water Quality-In February, 1974, the University of Montana Biological Station published "Land Use and Water Quality in the Flathead Drainage" (Ref. 16) an overview of the water quality problems in the drainage basin and particularly in Flathead Lake and how they are related to land use. This study was primarily a review of existing information.

Another study completed in 1974 by the University of Montana Forestry Dept. investigated the policies, guidelines, and enforcement procedures affecting pollution from forestry practices. (Ref. 18).

(g) Population and Land Use Information-Population estimates for the Flathead County area are available through the Flathead County Areawide Planning office (see also Ref. 13). Land use maps have been prepared for Flathead County by the same agency and for the Confederated Salish-Kootenai reservation area by the Tribal Planning Agency. Population information is available for the Reservation area through the Tribal Planning Agency.

(h) Water Quality Studies and Reports-The U.S. Geological Survey annually publishes "Water Resources Data for Montana" in two parts (Ref. 1 & 2). The first part addresses surface water records for stream flow gaging stations on many streams in the basin, and part two addresses water quality records for water quality stations located throughout the basin. Also, the U.S. Environmental Protection Agency recently completed a eutrophication survey on several lakes in the basin, as a portion of the National Eutrophication Survey. The lakes involved in this study include: Flathead Lake, Mary Ronan, McDonald, Swan Lake, Whitefish Lake and Tally Lake. Sampling stations are described in Section VIII of this report. The data is, as yet, unpublished, but the program is described in "Problem Lakes in the United States" EPA Technical Report 16010 EHR 12/71. Another report is on the eutrophication of Flathead Lake, including investigations of the limiting nutrients and the sources of nutrients, prepared by the University of Montana Biological Station on Flathead Lake (Ref. 9). In addition, a report was prepared by Dr. Lawrence Sonstelie discussing the eutrophication and land use problems as related to twelve heavily used smaller lakes in the upper Flathead drainage basin (Ref. 8).

In 1969, the Federal Water Pollution Control Administration prepared "Flathead Lake Bacteriological Survey" (Ref. 17). In addition to the above reports currently available or in preparation, a fairly large amount of raw water quality data is available through the Montana Dept. of Health & Environmental Sciences. This data includes a water quality study executed in 1973 and 1974, at which time water quality was measured at 11 stations on rivers in the upper drainage basin, on a routine monthly basis. Similar data is available for 14 other stations in the upper basin, but on a less regular basis. Many other sources of raw water quality are available, as evidenced by the many pages in Section VIII of tables documenting water quality sampling stations. Such data is most easily obtained by contacting the group or agency which did the sampling. Much of the data is unpublished and has not been analyzed thoroughly. Sources of published data include, in addition to the reports documented above, the following:

Montana Department of Health and Environmental Sciences "Logan Creek Water Quality Study, Fiscal Year, 1975" (Ref. 22), listing and partially interpreting water quality and biological data in a watershed being heavily logged.

Stanford, Ph D. thesis on Flathead River Stoneflies (Ref. 7), documenting biological sampling data, and summarizing unpublished water quality data collected by State Health Department on Flathead River and its three main forks.

In addition, the Montana Department of Natural Resources and Conservation has been funded by the State legislature (Ref. 26) to gather all existing water quality and hydrological data for the North Fork Flathead River and to make recommendations to the legislature. This study is in progress. Also in progress are the studies underway by the Flathead Drainage 208 Project (see Areawide Waste Treatment Management Plans-this chapter). Other on-going water quality studies include a continuation of the Logan Creek logging study (see above), continuation of the U.S. Geological Survey NASQAN water quality station on the North Fork Flathead River, Dr. Mark Weber's stream sediment sampling program, the Montana State Forest water quality sampling program in the Whitefish, Stillwater and Swan drainages, and the Montana Dept. Fish & Game temperature and basic water quality data monitoring above and below Hungry Horse Dam. All of these stations, with parameters measured, frequencies sampled and duration of study, are tabulated in Section VIII of this report.

(i) Waste Discharge Permits-Under the Federal Water Quality Act all industries and municipalities with discharges to surface waters have been issued waste discharge permits. One condition of these permits is a routine reporting of the water quality characteristics of their discharge. Records from this self-monitoring program are available for all dischargers in the basin through the State Dept. of Health & Environmental Sciences.

Areawide Waste Treatment Management Plans (Section 208)

Under Section 208 of the Federal Water Pollution Control Act, an areawide waste treatment management study is being conducted for the entire Flathead drainage basin, wholly including the area covered by this document. The 208 study is underway, and is being conducted by the Flathead Drainage 208 Project under the control of county, municipal and tribal authorities. The project is funded at approximately $500,000 for a 2 year water quality study which commenced in mid-summer of 1975.

Some of the projects to which the 208 agency is directing its attention include a large and detailed water quality sampling program on the North Fork Flathead drainage, a series of facility plans for sewage systems (none presently in the Upper Flathead drainage), a study of forestry activities, an irrigation-pesticide study, a small streams study, a land use capability study, a study of Hungry Horse Dam operations and a ground-water study.

Section 201 Facility Plans

At present, two facility plans are being prepared in the Flathead basin for the towns of Bigfork and Whitefish. These plans are being prepared by consulting engineers, with 75% EPA federal financing.

In addition, the Flathead Drainage 208 Project is investigating the need for facility plans for the communities of Somers, Lakeside and Swan Lake. The cities of Kalispell and Columbia Falls completed their sewage facilities prior to the federal requirement for facility plans. Kalispell was handled with an Interim Project Plan and Columbia Falls had a standard engineering plan.

Level B and Other Federal Plans

(a) Basin Planning-Under Section 209 of the Federal Water Quality Act, a basin plan has been prepared for the Flathead Drainage basin, under the primary jurisdiction of the State Dept. of Natural Resources and with the cooperation of a number of federal and state agencies. The draft version of this plan is now available, the final report will be printed later this calendar year.

(b) Comprehensive Framework Studies-The "Columbia-North Pacific Region Comprehensive Framework Study," (Ref. 10) is available in sixteen appendices, each appendix addressing a different topic, such as Water Resources, Irrigation, Fish & Wildlife, etc. The data is presented on a regional basis.

Local Plans

Comprehensive Plans-Comprehensive plans already prepared in the Flathead Drainage basin include Comprehensive Areawide Water and Sewer Plans for Flathead and Lake Counties (Refs. 11,12), general overviews of sewage problems and projected expansions in the unincorporated towns of Lake andFlathead Counties. "Comprehensive Development Plan, Flathead-Kalispell City-County Planning Area," including information on water and sewers. "Comprehensive Development Plan, Unit V, Lower Valley Area"-a comprehensive use plan for an area north of Flathead Lake.

Section 303(e) Water Quality Management Plans

At present, the "303(e)", water quality management plan for the Lower Clark Fork drainage basin is in draft form and soon to be completed. The Lower Clark Fork drainage basin includes the Flathead drainage downstream of Flathead Lake. The plan was prepared by the Montana State Dept. of Health and Environmental Sciences.

The upper Flathead water quality management plan (this document) covers the area immediately to the north thereof, and is similar in content.

IV BASIN PHYSICAL CHARACTERISTICS

The upper Flathead River basin (Fig. 1 and Plate 1) is in the northern Rocky Mountains and is characterized by a relatively narrow valley bottom, varying from six to fifteen miles wide, surrounded by high mountains to the east and by lower hills to the west. The southern portion of the valley is occupied by 183 mi.^{2} Flathead Lake, which is 28 miles long and is up to 15 miles wide. Most of the area is sparsely inhabited, Kalispell being the largest city with a population of 10,500. The basin is tributary to the Clark Fork of the Columbia River, which in turn enters the PendOreille Drainage, then the Columbia River.

Water quality in most waters of the basin is classified B-D1 (see appendix 2). Several waters are more stringently classified, including the Essex and Whitefish water supply intakes, Whitefish Lake and its tributaries, and Flathead Lake. Other waters have been assigned lower classifications, including Stillwater River, Whitefish River and Ashley Creek. These lower quality exceptions were made primarily because of the naturally sluggish nature of the streams, plus the additional effects in Ashley Creek of discharges from the Kalispell sewage treatment plant.

Waters classified as B-D1 are to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection, and any treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life; waterfowl and fur bearers; and agricultural and industrial water supply. General water quality requirements for those classifications of waters found in the upper Flathead drainage, and detailed water classification and water quality standards applicable to the basin are in Appendix 2.

CLIMATE

Upper Flathead drainage basin elevations range from over 10,000 feet on a few peaks in Glacier National Park to about 2900 feet on Flathead Lake. This difference of over 7,000 feet in elevation has a direct effect upon the climate of the region. The climate in general varies from a moist maritime-type in the upper valley, to a drier continental-type climate further south. Although the entire valley is affected by weather both from the Pacific Coast and from the Arctic, the dominant weather patterns vary from north to south. The Pacific air is more dominant during the winter and results in a milder climate than is characteristic of continental air masses.

Average temperatures are generally a little higher than in Montana east of the Continental Divide, due mainly to the sheltering effect of the Divide on polar air invasions during the winter. While cold waves of this type can occur when the polar air masses develop enough vertical depth to spill westward over the Divide, such cold spells occur only about half as often as in the more typical continental climate of eastern Montana. At the Glacier International airport in Kalispell the growing season is 135 days, but at Polebridge it is only 30 days. Flathead Lake has a growing season up to 140 days, Columbia Falls and Whitefish about 100 days, and West Glacier has a 90-day season.

Precipitation averages about 15 to 20 inches through the main Flathead Valley, but increases rapidly on adjacent mountain slopes due to their air lifting-cooling effect. Heavy snows of several hundred inches annually accumulate in the mountains. Approximately 40 to 60 percent of the annual precipitation occurs during the growing season, which varies considerably throughout the basin. Table 1 shows precipitation at Kalispell by month.

The moderating effect of Flathead Lake affects the climate around its shores by reducing daily fluctuations in air temperatures. This reduces the hazard of freezing. Fruit growers rely on this phenomenon in the spring to protect buds and blossoms in the orchards along the shores of Flathead Lake.

TABLE 1 PRECIPITATION IN KALISPELL, MONTANA
(Ref. 32)

MONTH	PRECIPITATION					SNOW
	Average[1]	Maximum		Minimum		Average depth[2]
	Inches	Inches	Year	Inches	Year	Inches
January	1.57	3.40	1943	0.27	1944	12.0
February	1.11	2.13	1940	.06	1934	9.0
March	.95	3.12	1898	.20	1926	6.5
April	.80	1.92	1948	.01	1924	1.7
May	1.46	4.50	1902	.34	1897	.3
June	2.06	4.56	1947	.40	1910	.2
July	1.10	3.15	1948	.09	1917	0
August	.87	3.28	1947	.01	1931	0
September	1.24	3.02	1900	.04	1928	.1
October	1.06	3.40	1914	(3)	1907	1.2
November	1.35	5.17	1897	.17	1929	8.0
December	1.45	4.78	1917	.26	1897	10.4
Annual	15.02	20.91	1948	10.39	1929	49.4

1 Average for a 52-year period, beginning 1897.
2 Average for a 50-year period, beginning 1897.
3 Trace

Hydrogeology

Groundwater is widely used in the Flathead River Basin primarily for domestic and stock use and to a lesser extent for irrigation, industry and public water supply. The majority of wells are located in the basin's large intermountain river valleys. The occurrence, distribution and quality of groundwater is closely related to the geology of the basin. The groundwater resources are greatly influenced by three geological units. These are Precambrian bedrock, Pleistocene glacial deposits and Recent alluvial deposits. The geological history of the basin includes long periods of sedimentation interrupted by periods of deformation and uplift which has created the lofty mountains of the region. Long periods of erosion have occurred and glaciation on a continental scale has greatly influenced the area.

The entire basin is underlain by a thick sequence of rocks of Precambrian age (over 600 million years old). These rocks have a total thickness of several tens of thousands of feet and have been partially metamorphosed and are predominatly vari-colored argillite, quartzite and carbonate rocks of the Precambrian Belt series. These rocks are tightly compacted and have very low porosity and permeability. With the exception of intermountain valleys, these Precambrian rocks are very widely exposed throughout the basin. Due to their low permeability, very little water is found in these rocks. If fractured and broken zones are encountered, the rocks can yield small amounts of fair to good quality water to wells.

During Pleistocene time (less than one million years ago), one or more very large ice sheets, believed to be several thousand feet thick, came down from Canada and covered much of the basin, including some of the mountainous areas. When the glaciers receded, they left thick deposits (especially in the lowland areas) of glacial till interbedded with glacial lake sediment. Lake sediments were deposited as a result of periodic damming of major rivers in the basin. The glacial deposits include terminal, lateral, recessional and ground moraines and silt and clay deposited in ancient lake Missoula. In addition to the deposits from continental glaciation, many valleys in the high mountains were influenced by glacial deposits derived from small local alpine glaciers. Glacial moraines are composed of hetrogeneous mixtures of silt, clay, sand, gravel and boulders.

Outwash channels and layers and lenses of sand and gravel also occur in these deposits and are the principal water-yielding materials. Thickness of glacial deposits varies from thin veneer a few feet thick to as much as several hundred feet. Wells drilled into glacial deposits vary widely in yield. Some wells yield little water, whereas other wells yield over 1,000 gallons per minute. Groundwater is recharged in the glacial deposits by infiltration of water from irrigated land and from numerous reservoirs, lakes in the area and from precipitation. Glacial deposits are exposed or underlie almost all of the intermountain valley areas in the basin.

Alluvial floodplain deposits of unknown thickness are present along major streams in the basin. These sediments are Pleistocene and Recent in age and are derived from the surrounding bedrock and glacial debris. In the Kalispell valley, alluvium underlies the floodplain of the Flathead and Whitefish rivers and constitutes an extensive aquifer (water-bearing formation) in that area. The aquifer is about 30 feet thick and supplies water to a large number of wells in the area. The aquifer is very permeable

and can yield large quantities of good quality water to wells and is recharged by precipitation and irrigation water. In other areas, recent alluvial deposits supply small to moderate quantities of water to wells. Although the quality of water in recent alluvial deposits generally is good, there are some localized areas where it is fair to poor.

In general, the groundwater resources in the Flathead River valley are unpolluted. There are, however, some localized areas in the basin that do have groundwater pollution problems. Wastes from septic tanks can create localized problems. Where there are a number of septic tanks and individual water supplies using wells, groundwater pollution and public health problems can occur if disposal systems are not properly designed and located. Groundwater pollution due to disposal of wastes from septic tanks has tentatively been identified in the Evergreen area east of Kalispell and around a number of small lakes in the basin. There has been a growing concern in the basin about the eutrophication of many small lakes and some of this eutrophication has been attributed to subsurface disposal of septic tank wastes. Other pollution problems that have been identified are localized areas of groundwater pollution from wood products industries in the Kalispell valley. The extent of this problem has not been well determined.

Soils

The Soil Conservation Service has published a soil survey (Ref 35) which delineates soil types in great detail in most of the main valley region of the upper Flathead drainage basin. The survey was done primarily for agricultural interests, and does not include mountainous or federal lands. Accompanying the soil survey is an engineering report (Ref. 36) which discusses the capabilities and limitations of the soil types. Topics of interest to water quality and public health are listed for each soil classification. The report suggests restrictions on septic tanks use for the following soil types:

(1) Impermeable soils (Whitefish group, including the clayey soils surrounding Whitefish).

(2) Areas of high groundwater (Evergreen area, especially eastern part).

(3) Floodplain areas (particularly along margins of Flathead River. Also includes alluvial deposits).

(4) Steep slopes (steeper sidehills cause sewage to "daylight" on the surface near drainfields).

(5) Rocky or cobbly areas (difficulty of drainfield construction + lack of percolation ability).

The soils in the mountainous and foothill areas surrounding the Flathead valley have not been classified. These soils are usually shallower than valley deposits, with bedrock exposed in many areas. Percolation rates in foothill areas are usually quite slow, averaging 20 to 30 minutes per inch, while valley percolation rates are usually much faster. The soils in the foothill areas are mostly forest duff deposits, two to four feet thick, overlying bedrock or pockets of glacial till deposits. A few marshy areas are found near the base of the foothill areas, such as the Lazy Creek drainage above Whitefish Lake, where the soils are black, of organic origin, wet and thick.

Most of the valley soils were deposited by glacial action during the Pleistocene epoch. As such, the soils are randomly mixed, with clayey and unsorted deposits common. The glaciers were quite deep in the valley, at one time reaching a depth equivalent to mid-slope on the Big Mountain ski runs. During late glacial times, giant Lake Missoula deposited much of the fine silty deposits which make up the present surface soils in the valley area above Flathead Lake. During later times, stream action deposited the alluvial swaths that parallel and underly the streams of the drainage.

Land Use

The Flathead River basin above Polson comprises an area of 6,646 square miles, or 4,253,440 acres. Flathead County and smaller portions of Lake, Powell and Lewis and Clark counties are also included in the planning area.

Over 116,000 acres are presently in crop production, with as much as 30,000 acres being irrigated. There are 75,000 acres classed as pasture and range. Over 3 million acres are classed as forest lands, a significant portion of which is grazed by both domestic livestock and game animals. Urban and built-up areas occupy about 18,000 acres, while other lands, which include farmsteads, private roads, feedlots, ditch banks, rural non-farm residences and borrow areas total over 10,000 acres. Small water areas occupy over 6,500 acres in Flathead County alone.

Water Use

The irrigation of agricultural land accounts for the largest use of water in the Flathead basin. Over 30,000 acres are presently irrigated in Flathead and upper Lake county. Water use for irrigation is estimated at over 118,000 acre feet annually of which the net depletion exceeds 55,000 acre feet.

Non-irrigation water use in Flathead County exceeds 12 million gallons per day or over 13,000 acre feet per year. Municipal use is 5.3 mgd while rural use equals 1.9 mgd, livestock use equals .4 mgd and self-supplied industry uses 4.5 mgd. Groundwater supplies 9 mgd and surface water supplies the remaining 3 mgd.

There are three hydroelectric generation facilities in the Flathead basin. They are: Hungry Horse Dam on the South Fork of the Flathead, Bigfork Dam on the Swan River and Big Creek Dam on Big Creek near Polson. The average annual flow (1970) of the Flathead River at Polson is 10,890 cfs or 8,469,000 acre feet per year.

Population and Economics

For this profile, 1970 census data from county census divisions has been summarized to approximate actual Flathead basin statistics. The census gives a county-by-county summary of people and jobs as of 1970. This data has been applied to historical data and county projections to yield Table 2. The economy of the basin is based on manufacturing, forestry, agriculture and tourism. As Table 4 shows, manufacturing has a predominant role in the basin's economy; 21.1 percent of the total employment is involved in manufacturing. Lumber and wood products are most significant in terms of wages and salaries paid. The aluminum plant at Columbia Falls provides employment for many of the basin's residents.

Agriculture is another prominent economic activity. Approximately ¼ of Flathead basin's cropland and pastures are irrigated, causing the total crop value of irrigated lands to exceed the total crop value of non-irrigated crop lands. Hay, pasture, corn for silage, wheat, barley, potatoes and cherries are the major crops.

Receipts of livestock are more than twice those of crops. Dairy sales are of significant importance and are growing in importance.

Aesthetic and scenic resources are of national importance. Congress has officially established Glacier National Park and the Bob Marshall Wilderness Area to protect the environmental quality of the basin.

Outdoor recreation is popular and its stimulation of the local economy is evident in retail establishments, markets, restaurants and private recreation facilities. Hunting, fishing, boating, skiing, hiking, camping and scenic touring attract tourists from the entire nation.

Kalispell, Whitefish and Polson are the chief trading areas of the basin. Kalispell with a 1970 population of 10,526 is the largest city in the basin.

Table 2 summarizes both historical population and employment of the basin from 1930 to 1970. Historical projections have been made for 1980 and 1985.

Although mining is of minor importance to the basin's economy, oil and gas leases have been applied for in the national forest and if oil extractions were to materialize it could have a significant impact upon the economy. Possible coal development in Canada could lead to an economic impact in the basin.

With an aluminum plant in Columbia Falls, one of the basin's characteristics is a high consumption of electricity. Future plans will have to include methods of supplying electricity for the constant demand of the aluminum plant and the growing demand of the rest of the basin.

TABLE 2

FLATHEAD BASIN POPULATION AND EMPLOYMENT
HISTORICAL AND PROJECTED [a], 1930-1985

YEAR:	1930	1940	1950	1960	1970	1980	1985
POPULATION:	23,798	30,773	38,163	39,281	46,422	49,548	51,612
EMPLOYMENT:	9,069	8,946	12,551	12,362	14,699	15,352	15,889

[a] The projections are historical projections.

Communities of the Flathead basin are listed below with their 1970 populations.

TABLE 3

FLATHEAD BASIN: COMMUNITIES OF 100 PEOPLE OR MORE

COMMUNITY	COUNTY	1970 POPULATION
Big Arm	Lake	250
Elmo	"	210
Rollins	"	100
Swan Lake	"	300
Bigfork	Flathead	500
Columbia Falls	"	2,652
Coram	"	500
Hungry Horse	"	700
Kalispell	"	10,526
Lakeside	"	600
Martin City	"	500
Olney	"	250
Somers	"	889
West Glacier	"	350
Whitefish	"	3,349

TABLE 4

FLATHEAD BASIN, EMPLOYMENT BY GROSS SECTORS, 1970

SECTOR	NUMBER	PERCENT OF TOTAL
Agriculture	1,055	7.2
Construction	1,041	7.1
Eating and Drinking Places	719	4.9
Education	1,097	7.5
Forestry and Fisheries	180	1.2
General Merchandise Retailing	350	2.4
Health Services	738	5.0
Manufacturing	3,099	21.1
Mining	33	.2
Motor Vehicle Retail Service	479	3.3
Legal, Engineering, Miscellaneous Professional Services	206	1.4
Other Retail Trade	1,008	6.9
Public Administration	711	4.8
Railroads	550	3.7
Other	3,433	23.3
TOTAL	14,699	100.0%

BIOLOGICAL CONDITIONS

The upper Flathead drainage contains some of America's last truly wild rivers, as well as Flathead Lake, one of North America's largest oligotrophic water bodies. Many of the tributaries of Flathead Lake, most notably the Middle and North Forks of the Flathead River, provide vital spawning grounds for the native cutthroat and dolly varden trout of the lake. Kokanee salmon from the lake also utilize these streams for spawning and for passage to several of the clear, deep lakes within Glacier National Park. The South Fork of the Flathead also contains the native trout species, although their migration to Flathead Lake has been eliminated by Hungry Horse Dam. The Swan River, which drains the Mission Mountains Wild Area, contains good rainbow and dolly varden populations; however, a diversion structure (for hydroelectric power) near its mouth has greatly reduced the spawning runs from Flathead Lake. The Stillwater River presently has only brook trout and cutthroat trout populations. Cutthroat trout, arctic grayling and three species of whitefish inhabit numerous mountain lakes within the Bob Marshall Wilderness area. Several low-elevation lakes, e.g. Lake Mary Ronan and Echo have good large mouth bass populations. Smallmouth bass are found in Horseshoe Lake. Lake McDonald, Whitefish and Flathead Lakes are nationally known for their large (40 pound +) lake trout. Some of the largest yellow perch in the state are found in Ashley Lake.

Several small lakes, and also Echo and Lake Mary Ronan, have growing eutrophication problems, thought to be mainly due to domestic sewage from lakeside homes. This acceleration of algal production is causing reductions in the carrying capacity of the game fish populations within the lakes. As should be expected, the water quality in the Bob Marshall and Mission Mountain back country is very good, although recreational homes, with their ever present septic tank and soil destabilization problems, are infringing along the Swan River and the Middle Fork of the Flathead. Domestic sewage and irrigation diversions have reduced the spawning grounds of the kokanee and trout populations in several tributaries of the Flathead River. The Whitefish River and Ashley Creek have historically had problems with domestic sewage from the cities of Whitefish and Kalispell, while the Stillwater River has temperature and low flow problems associated with irrigation dewatering. The North Fork is also threatened with water quality degradation from a planned Canadian coal mining operation just north of the United States border and from possible petroleum exploration and oil refining (north of Columbia Falls). Of course, Flathead Lake itself is not immune from these impacts upon its tributaries.

The upper Flathead is one of the fastest growing areas in the state. Growth, in turn, brings numerous inherent water quality problems to the area--expanded water use, expanded loads of domestic and industrial wastes, expanded non-point problems from heavier land use and expanded access to areas which were once nearly isolated from people. In today's growth oriented society, native aquatic populations and their interrelated terrestrial ecosystems are indeed rare. The nondegradation policy for water quality needs to be strictly enforced in waters which still contain this priceless heritage.

V. MONTANA WATER POLLUTION CONTROL PROGRAM

INTRODUCTION

Water quality management planning is part of a broad, comprehensive water pollution control program administered by the Water Quality Bureau of the Environmental Sciences Division of the Montana Department of Health and Environmental Sciences. Details of this program are described in annual reports of the bureau. Important elements of the state program are:

1. State and federal waste discharge permit programs.

2. Water quality standards.

3. Statewide monitoring and surveillance.

4. Facilities construction grants, plan review, operation and maintenance inspections, training and licensing of operators.

5. Public participation.

6. Enforcement.

STATE AND FEDERAL WASTE DISCHARGE PERMIT PROGRAMS

The present state program of issuing waste discharge permits is operated under the authority given by the Montana water pollution control law and the Montana Pollutant Discharge Elimination System (MPDES). At the present time, the U. S. Environmental Protection Agency (EPA) is also issuing waste discharge permits in the state of Montana to federal facilities and to discharges, from other than incorporated communities, on Indian reservations. The permits are being issued pursuant to the National Pollutant Discharge Elimination System (NPDES) created by the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA of 1972). To eliminate the duplication of effort which formerly existed, the state of Montana applied for and received authority from EPA to issue NPDES permits in Montana. Section 402

of the FWPCAA of 1972 provides that states with adequate water pollution control programs may apply for and receive authority from EPA to issue discharge permits under the necessary revisions to the state water pollution control statutory authority for administration of the NPDES program in Montana. The Montana Department of Health and Environmental Sciences was given the authority to administer the waste discharge permit program on June 10, 1974. Waste discharge permits issued under the NPDES prior to the MPDES permit program will serve as MPDES permit until their date of expiration. All MPDES permits issued meet the minimum requirements of the EPA for NPDES permits.

The Federal Water Pollution Control Act Amendments of 1972 established the following time schedule for upgrading waste treatment facilities.

MUNICIPALITIES

1. Secondary treatment by July 1, 1977 or any more stringent limitation necessary to meet water quality standards.
2. Best practical control technology by July 1, 1983.
3. No discharge of pollutants by 1985 (goal)

INDUSTRIES

1. Best practicable control technology by July 1, 1977.
2. Best available control technology by July 1, 1983.
3. No discharge of pollutants by 1985 (goal)

NATIONAL SECONDARY TREATMENT REQUIREMENTS (FWPCAA OF 1972)

Minimum five-day biochemical oxygen demand (BOD_5) reduction of 85 percent.

Minimum suspended solids reduction of 85 percent.

Maximum effluent BOD_5 of 30 mg/l on monthly average and 45 mg/l on weekly average.

Maximum effluent suspended solids of 30 mg/l on monthly average and 45 mg/l on weekly average.

Maximum effluent fecal coliform of 200 organisms/100 ml on monthly average and 400 organisms/100 ml on weekly average.

pH limits on effluent maintained between 6 and 9.

Self-monitoring of these parameters is required. The frequency of monitoring is based on the population served and the complexity of the treatment facility and is stated in the NPDES or MPDES permit. In addition, some municipal dischargers are limited for and required to monitor effluent oil and grease.

WATER TREATMENT PLANT TREATMENT REQUIREMENTS

There are no parameters specified by the FWPCAA of 1972 to be monitored for water treatment plant discharges. The following requirements are being placed on NPDES permits issued in Montana:

1. No change in operating procedures will be allowed that would result in a less desirable discharge.

2. As soon as practicable but no later than July 1, 1977:

Total suspended solids (TSS)	<45 mg/l weekly average <30 mg/l monthly average
Total dissolved aluminum	1.0 mg/l monthly average <1.5 mg/l grab sample
pH	Maintained between 6.0 and 9.0

INDUSTRIAL BEST PRACTICABLE CONTROL TECHNOLOGY REQUIREMENTS (FWPCAA OF 1972)

Industrial waste dischargers will be required to provide the best practicable control technology currently available in treatment of their waste discharges. The parameters will be limited and monitored, and the frequency of monitoring will vary with the different types of industries. The specific parameters to be limited and monitored and the frequency of monitoring are stated in the NPDES or MPDES permit.

AGRICULTURAL TREATMENT REQUIREMENTS (FWPCAA OF 1972)

Any animal confinement facility which on any 30 days during the previous 12 months contained 1,000 or more animal units or any animal confinement facility,

without regard to size, which discharges to state waters must apply for a waste discharge permit. The following is a list of the number of animal units for those types of animal confinement facilities in or expected to be in operation in Montana:

Slaughter and Feeder Cattle	1.0 animal units/animal
Mature Dairy Cattle	1.4 animal units/animal
Swine over 55 pounds	0.4 animal units/animal
Sheep	0.1 animal units/animal
Fish (where discharge occurs on at least 30 days/year)	0.05 animal units/pound

The waste discharge permits issued for animal confinement facilities will generally prohibit any discharge of pollutants unless rainfall in excess of the 10-year/24-hour rainfall or equivalent moisture has been received.

Irrigation return flows will be subject to MPDES permit if there is a point source discharge through a man-made or man-maintained drainage system from 3,000 or more irrigated acres. The parameters to be monitored and the frequency of monitoring will be stated on the discharge permit.

WATER QUALITY STANDARDS

Water pollution control started in Montana in 1907 with passage of legislation designed to protect domestic water supplies. A more comprehensive law was passed in 1955 that dealt with control and protection of water for recreation, agriculture, and industry. The 1955 law also established a water pollution control council and charged it with the tasks of classifying all streams in the state according to their most beneficial uses and establishing water quality criteria for the streams. The 1955 law also involved upgrading the treatment of wastes going into the streams. Montana thus became one of the first states to have enforceable stream classifications.

In 1965, the U. S. Congress passed the Federal Water Quality Act which required that all states classify and

establish water quality criteria for their interstate streams by July 1, 1967. Montana revised its standards for both interstate and intrastate waters and required a higher degree of stream quality than before. Secondary treatment or the equivalent was required of municipal and industrial discharges. In October, 1972, the Federal Water Pollution Control Act Amendments were passed expanding the authority of the Environmental Protection Agency. Uniform water quality standards and enforcement procedures throughout the United States became the objective. Montana revised its water quality standards and adopted these revised standards on July 13, 1973. The new standards became effective in November, 1973.

Montana water quality standards serve as a functional tool in protecting water quality; however, a number of laws, statutes, and regulations complement the water quality standards and significantly assist in protecting water quality.

STATEWIDE MONITORING AND SURVEILLANCE PROGRAM

Prior to 1972, Montana had done little water quality monitoring due to inadequate funding. With increased appropriations provided by the 1971 legislature and the federal government, the state greatly increased its effort. Personnel were added to the staff, and laboratory capabilities were expanded. The present state monitoring program includes compliance monitoring of point sources of wastes including monitoring of municipal and industrial wastes, long-term baseline monitoring of streams, and a statewide program for determining the general quality of all significant surface waters.

The statewide inventory of water quality will identify areas with water quality problems and will provide basic data for water quality management and planning programs. Included in the monitoring is a statewide assessment of the trophic (pollution level) status of Montana's lakes, reservoirs, and ponds. This program is coordinated with the EPA National Eutrophication Survey.

FACILITIES CONSTRUCTION, OPERATION, AND MAINTENANCE

A minimum requirement of primary treatment for all domestic sewage was first adopted by the Montana Board of Health

in 1952. All of Montana's communities have met this requirement, and many of the communities are upgrading their facilities to secondary treatment or are in the process of constructing or planning secondary treatment systems. Since 1956, there has been a federal grant program to assist municipalities in the construction of sewage treatment facilities, including outfall and interceptor sewers. In 1971, the Montana state legislature appropriated $4,000,000 to aid municipalities in construction of these same facilities. The 1973 legislature appropriated $1,600,000 to reimburse municipalities that had proceeded with construction since July 1, 1966, without waiting for state grants. With passage of the Federal Water Pollution Control Act Amendments of 1972, 75 percent of eligible project costs are federally financed. Due to a shortage of federal grant funds, a priority system for allocation must be used. The state, under EPA guidance, establishes priorities for proposed waste treatment projects.

An important part of municipal sewage treatment is proper operation and maintenance of facilities after construction is completed. In an effort to improve operation and maintenance, the state has conducted an operators' school each year. During recent years, this school has had about 100 operators attending. In 1971, a grant was obtained from the federal government for employing two training instructors to establish training programs throughout the state. This activity is in addition to the annual school.

An operators certification program was established in 1968 following enactment of a law requiring certification of those responsible for the operation of sewage treatment or industrial waste treatment systems.

PUBLIC PARTICIPATION

Public participation in the water pollution control is an increasingly important aspect of the state program. Public hearings are held concerning proposed regulations, water quality management plans, and waste discharge permit applications. The state also has an environmental impact statement requirement. These statements are presented to the public for comment, and hearings are conducted on highly controversial issues.

The public also is kept informed by means of a water pollution control advisory council which has been established by law to assist the Water Quality Bureau in preparation of rules and regulations and dissemination

of information to interested groups. Similarly, public meetings are attended on request, and a quarterly newsletter is published by the Water Quality Bureau.

ENFORCEMENT

Montana's laws on water pollution basically state (1) it is unlawful to cause pollution or place materials in a location where they are likely to cause pollution of state waters, and (2) discharge of waste material into state waters without a permit from the Department of Health and Environmental Sciences. Two administrative rules have been adopted by the Board of Health and Environmental Sciences which are the chief elements in Montana's water pollution control program. Montana's water quality standards serve as the primary means for defining pollution, and the Montana Pollutant Discharge Elimination System rule provides the mechanism for authorizing and controlling point source discharges to state waters. Violators of the law, a rule, permit, or order could be subject to injunction, civil penalties up to $10,000 for each day of violation, or criminal penalties with fines not to exceed $25,000 per day of violation and/or imprisonment for not more than one year for an initial conviction and not more than $50,000 per day of violation and/or imprisonment for not more than two years for subsequent violations. Significant steps were taken in 1974 to establish a workable enforcement program, including increasing the legal staff and additional allocation of technical staff.

VI. WATER POLLUTION SOURCES

Water pollution in the Flathead drainage basin is caused by several factors including municipal and industrial discharges, agricultural effects and non-point sources. In addition, natural water quality problems occur seasonally from runoff associated with erosion. Characteristics of significant municipal and industrial discharges are summarized in Table 6.

Information relative to all municipal and industrial waste discharge permits is given in Section IX of this plan. For the following discussion, the term "Secondary Treatment" whether applied to industrial or municipal discharges; is defines as follows:

AVERAGE ALLOWABLE EFFLUENT CONCENTRATION (mg/l)

Parameter	30 Consecutive Day Period a/	7 Consecutive Day period b/
BOD_5	30	45
Total Suspended Solids	30	45
Fecal Coliform (Number/100 ml) c/	200	400

Additional effluent limitations are:

1. Total residual chlorine concentration shall not exceed 0.5 mg/l in any grab sample.

2. No visible oil or grease or floating solids in the discharge. pH units shall remain between 6.0 and 9.0 d/

3. Arithmetic mean of the total BOD_5 and the total suspended solids concentrations for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the concentrations for influent samples collected at approximately the same times during the same period (85 percent removal). This is in addition to the concentration limitations of total BOD_5 and total suspended solids. a/ For compliance purposes, this limitation shall be determined by the arithmetic mean of a minimum of three (3) consecutive samples taken on separate weeks in a 30-day period (minimum total of three (3) samples); not applicable to fecal coliforms-see footnote c/.

a/

For compliance purposes, this limitation shall be determined by the arithmetic mean of a minimum of three (3) consecutive samples taken in a 7-day period (minimum total of three (3) samples); not applicable to fecal coliforms - see footnote c/.

b/

c/ For compliance purposes, averages for fecal coliforms shall be determined by the geometric mean of a minimum of three (3) consecutive grab samples taken during separate weeks in a 30-day period for the 30-day average, and during separate days in a 7-day period for the 7-day average (minimum total of three (3) samples).

d/ For compliance purposes, any single analysis and/or measurement beyond this limitation shall be considered a violation of the conditions of this permit.

MUNICIPAL DISCHARGES

Several communities in the study basin discharge treated sanitary wastewater to adjacent streams (Figure I and Plate I). Individual municipal treatment facilities for the sewered communities in the Flathead River basin are discussed as follows:

Columbia Falls Sewage Treatment Plant

About 2,000 people are presently served by the Columbia Falls sewage treatment plant. Present flow averages about 140,000 gpd. Its design capacity is 5,000 people and 500,000 gpd. The sewage treatment plant is located on land adjacent to the Veterans Home and also serves the Home. Discharge is to the Flathead River. The treatment facilities consist of an aeration basin, tube settlers and filters for removal of suspended material and chlorination. Sludge from the sludge storage pond is dried in drying beds or pumped to a truck and spread on nearby fields. Problems have been experienced with operation of the facilities, the most serious arising with the excessive amount of time required to handle the sludge. However, with the present loading, the City appears to easily meet the secondary treatment requirements that are set forth in their wastewater discharge permit. Additional loading may present problems with filter capacity unless suspended solids are reduced in the filter influent.

Whitefish Sewage Treatment Facility

About 3,400 people are presently served by the City's sewage lagoons. The lagoon system consists of two 14.6 acre cells operated in series, and continuously overflowing to the Whitefish River. A flow of about (500,000 gpd) is received at the treatment facilities. The facility plan (Step 1) is nearly completed by the City's consultant who has indicated that most of the infiltration can be easily eliminated. The city, to meet secondary treatment requirements and predicted population increase, is planning extensive improvements to the present treatment system. The City's present MPDES permit allows a discharge ot 50 mg/l BOD for a 30-consecutive day period and 70 mg/l BOD for a seven day consecutive period. There are no limits for suspended solids or coliform bacteria at this time.

June 1, 1977. Any improvement provided should allow for expansions in the future for nutrient removal. The city also has needs for extending their sewerage system to serve unsewered populated areas along Whitefish Lake and River and to eventually pick up the Big Mountain area. The biggest need for interceptors at this time is for sewer to serve the Department of Fish and Game campground on the west shore of Whitefish Lake.

Big Mountain Sewer District

This District serves the Winter Sports-Big Mountain Ski Resort with its lodges, private housing and condominiums. Present facilities consist of 3 ponds containing about six acres of surface area with the first two ponds aerated and the third designed as a holding pond. It is expected that it will be several years before the ponds reach an overflow level. Before this occurs, a spray irrigation system will be utilized for final disposal of the wastewater. In terms of wastewater volume, peak equivalent population loading to this facility during the winter is approximately 300 persons. The design equivalent population loading of the new facility is 515 persons. The former treatment facilities (before late 1975) consisted of aeration basins with discharge of effluent during the spring to First Creek of the Haskill drainage. The new facilities are located in the Hell Roaring Creek drainage. Long-range planning is for the area sewage to be connected to the city of Whitefish system.

Ptarmigan Properties

This property is located near the Big Mountain complex and consists at the present time of seven buildings each containing seven living units and five individual units. The sewage is treated in an extended aeration plant with a rated capacity of 10,000 gpd. Effluent from this unit is discharged to a 2.0 million gallon reservoir which to date has not filled. It is planned to irrigate with the reservoir water if the reservoir fills. When an interceptor is provided to the Big Mountain area, the Ptarmigan Properties should connect to it. Additional capacity in the extended aeration facility is needed when additional units are added. The treatment units are located in the Whitefish Lake drainage. Solids concentrations are controlled by occasionally wasting sludge by means of septic tank pump trucks, which haul the sludge to approved dump sites.

Kalispell Sewage Treatment Plant

About 10,500 people are presently served by the Kalispell sewerage system. The flow to the plant averages about 1.3 mgd. The Kalispell plant secondary treatment facilities were placed into operation during 1974. Before this, primary treatment was provided. The plant has a comminutor, grit removal unit, two primary clarifiers, two ABF towers which combine trickling filter and activated sludge treatment, a secondary clarifier with sludge recycle, multi-media sand filters and chlorination facilities with discharge to Ashley Creek. Sludge is treated through a BIF chlorination system with discharge to sludge ponds. Sludge from the ponds to date has been disposed of in the city landfill. As the sludge is highly oxidized and disinfected through the sludge treatment process, this material should be utilized and will probably be considered for use as a soil conditioner.

The plant is designed for a population of 16,000 and an average flow of 2.7 mgd with peak flows of 7.2 mgd. The high peak flows occur with storm runoff as about 40% of the area runoff enters the city sanitary sewer system creating both a backup of sewage within the sewers and treatment problems. The city is actively pursuing a storm and sanitary sewer separation program with planned treatment of the storm water. The only discharge of industrial wastewaters of any consequence to the city system is that received from the Equity Supply Company which is a milk processing plant. The city has an MPDES permit with standard secondary treatment limitations, except for BOD and suspended solids. The BOD limit is 20 mg/l on a monthly average and 30 mg/l on a weekly average. For suspended solids it is 10 and 20. These lower limits were estabished for Kalispell because the federally funded plant was designed to achieve such levels. These limitations have not been met continuously. While the receiving waters are small and the resulting quality poor, the E-F standards are apparently being met in Ashley Creek. Future data may show oxygen levels to be below the 3 mg/l limit.

There are areas adjacent to the city of Kalispell which are in need of a sewerage system. These are principally the Evergreen and Woodland Park areas which have an estimated population of 3,700 people. The Evergreen area ia largely on the floodplain and has a high groundwater table compounding individual sewage disposal problems. To date little interest has been shown by people in the area for a sewage collection system.

Glacier National Park

A new disposal system was completed during 1975 to serve the major facilities on the west side of Glacier National Park. This system consists of aerated lagoons, holding ponds and spray irrigation for final disposal. This system is replacing the trickling filter facility formerly used for the Lake McDonald area and the septic tanks and drainfields utilized around the Park Headquarters and Apgar.

Lakeside Air Force Base

This installation consists of a three-cell lagoon system, totaling 8 acres of surface area, designed on a 20 persons/acre basis and with final discharge used for irrigation of nearby land. This system no longer discharges to surface waters.

University of Montana-Yellow Bay Biological Station

A treatment facility to replace malfunctioning septic tanks and drainfields was placed into operation in 1974. The plant consists of an extended aeration treatment facility, a combined mixing, coagulation and settling unit for removal of phosphorus and sand filter and chlorination facilities with discharge to Flathead Lake away from the Bay area. The plant is designed for a population of 390 and a flow of 33,000 gpd. There is essentially no flow during the winter months. The plant also serves an adjacent state campground. Discharge limits are for secondary treatment with an additional limit of 0.5 mg/l phosphorus on a 30-day average and 0.75 mg/l on a 7-day average. Sludge is trucked to the Polson-Pablo landfill.

Community of Elmo

The sewage from about 100 residents is pumped to a one half acre stabilization lagoon above the community. Problems have been experienced during the spring of the year when groundwater enters the sewerage system, overloading the pumping station and causing overflows of the lagoon to a nearby field.

Community of Bigfork

Bigfork's sewerage system and treatment facility was placed into operation in 1965 and consists of a Dorr-Oliver Duo Clarigester, trickling filter and chlorination facilities with discharge to the Swan River a short distance above Flathead Lake. The plant was designed for a population of 2,400 and a flow of 240,000 gpd. Sludge is hauled in the liquid form during warm weather to an alfalfa field about ¼ of a mile northwest of the plant. A facility plan for upgrading the treatment facilities and reducing infiltration is presently being prepared (Ref. 21). When Flathead Lake is at its highest level, infiltration is estimated at 60,000 gpd. Flows at the plant presently range from 0.06 mgd to 0.18 mgd. The permanent population connected to the system is estimated at 500 with possibly double this amount contributing in the summertime. The self-monitoring reports indicate that the existing limits (BOD and SS of 50 mg/l on 30-day and 70 on 7-day) for the plant are not being consistently met. With the present loading, the plant should be capable of nearly meeting even the secondary treatment limits that are proposed for July 1, 1977. A detailed field analysis is needed to determine the reasons for the higher BOD's that are reported. The consultant has proposed extensive additions to the plant. Consideration should be given to providing minor improvements at the plant with land disposal of the effluent to provide a high degree of treatment. The consultant has indicated that suitable land for this purpose may be difficult to obtain.

Hungry Horse Dam Sewage Plant

A package extended aeration plant with chlorination serves 26 employees at Hungry Horse Dam and seasonally (May-September) serves an average of 440 tourists per day. The peak tourist day is 1,200. The plant is designed for an average daily flow of 9,000 gallons with discharge to the South Fork Flathead River. The Visitor Center is served by a cavitette type extended aeration plant designed for an average daily flow of 3,000 gallons, with effluent discharged to a drainfield. Mixed liquor solids are controlled by wasting sludge via pump truck to approved sites.

Hungry Horse Government Housing Area

In the town of Hungry Horse, some 6 homes, a small school and a small office force are served by a large Imhoff tank sewage plant, which provides primary treatment. Effluent from this tank is disposed of in a subsurface drainfield, with no discharge to surface waters. The system was originally designed for loads greatly in excess of the present number of users. Ownership of this facility has recently been transferred from the Bureau of Reclamation to the U.S. Forest Service.

Anaconda Aluminum Co. Sewage Plant

Sewage from the employees of the Anaconda Aluminum plant at Columbia Falls is treated in a sewage disposal plant consisting of a 3000 gallon aeration tank, a sludge digester, final chlorination and final discharge to a seepage pond adjacent to the Flathead River. In this seepage pond, the 100,000 gallons per day of treated sewage is combined with some four million gallons per day of uncontaminated cooling water and both seep into the groundwater with no direct surface discharge. Solids levels in the aeration plant are controlled by sludge wasting and land disposal.

Holland Lake, U.S. Forest Service Campground

The Holland Lake campground facilities are located at Holland Lake in the upper part of the Swan River drainage. Sewage flow from these facilities and a travel trailer dump station is generated by an estimated 100 boat launch users, 200 beach day-users and 205 campground users, maximum. A sewage system serves the area and is designed to treat 7000 gallons per day. A 0.15 acre sealed aeration lagoon is followed by a 0.3 acre evaporation-percolation pond. No overflow of these facilities has occurred to date, and if the need to have an overflow arises, a sewage spray field probably would be installed.

Package Aeration Plants with Soil Disposal

Two package aeration plants are in use in the upper Flathead drainage basin, with effluent disposed of in subsurface drainfield systems. Fort Kalispell, located 3½ miles east of Kalispell, and a private subdivision located 1 mile east of Kalispell, utilize such systems.

Glacier Park Co., Somers

Sewage generated by employees of the Glacier Park Company post-treating plant in Somers is discharged to a 2.2 million gallon, 0.5 acre non-overflow lagoon. No discharge has occurred from this lagoon to date.

MUNICIPAL TERTIARY TREATMENT

The "non-degradation" clause in the Montana water quality standards requires that new discharges be treated to such an extent that no deterioration of the receiving waters will result. For high quality waters such as Flathead Lake, this essentially means tertiary treatment (secondary treatment + nutrient removal). Tertiary plants are expensive to construct and operate. To date, the only tertiary plant in the upper Flathead drainage basin is a small unit on the east side of Flathead Lake, serving the University of Montana Biological Station and the adjacent State campground. This plant discharges phosphates in concentrations only about one-third as great as the four secondary sewage plants discharging in the basin.

Tertiary treatment has often been suggested as a mandatory requirement for the four municipal sewage plants discharging to streams tributary to Flathead Lake. The concern over nutrients is, practically speaking, related to discharges containing phosphates. Phosphates have been shown to be the limiting nutrient for algal growths in Flathead Lake (Ref. 9), meaning that controlling phosphate additions will prevent the proliferation of the algae.

At present, a full year's nutrient data is available for the four discharging sewage plants in the upper Flathead drainage basin. The information shown in Table 5 is average data essentially for twelve month periods, and is considered quite reliable. The phosphate data for the four discharging plants is summarized as follows:

TABLE 5 PHOSPHATE CONTRIBUTIONS FROM SEWAGE PLANTS

Sewage Plant	Avg. Flow (MGD)	Avg. PO_4-P Concentration (mg/l)	Avg. PO_4-P (lbs/day)
Columbia Falls	0.16	11.6	15.5
Whitefish	0.46	7.4	28.4
Kalispell	1.3	8.3	90.0
Bigfork	0.091	8.9	6.8

TOTAL 140.7 lbs/day

A phosphorus budget for the drainage basin has been attempted in Section VIII of this plan. According to that budget, the total contribution of phosphorus from all four of the sewage plants combined amounts to less than 5% of the total for the basin. Tertiary treatment could remove approximately 70% of the phosphorus from these four sewage plants, but this would amount to less than 4% of the phosphorus entering Flathead Lake. It appears that this very expensive task is not warranted at this time.

INDUSTRIAL DISCHARGES

While several industrial waste disposal facilities are utilized in the upper Flathead drainage basin, only one involves a direct discharge to surface waters and none cause water quality standards to be violated.

Burlington Northern Railroad, Whitefish

Waste flows from the railroad roundhouse area are treated in a chemical coagulation plant. Spillage from a railroad fueling area is routed to an API oil separator, from which oil is reclaimed by means of a belt skimmer. Oil seepage in the groundwater is intercepted along the bank of the Whitefish River, by means of an impervious barrier and is collected and pumped to the API separator. All treated wastewaters are then discharged to a 2-cell, 0.9 acre stabilization lagoon, with final discharge to a final oil separator, then to the Whitefish River.

The serious oil problems which were much in evidence in recent years have been eliminated by the installation of these interception and treatment facilities. The quality of the final effluent is, according to self-monitoring data, well within the limitations of the MPDES discharge permit.

Glacier Park Co., Somers

Oily and phenolic wastewaters from the Somers tie-treating plant are discharged to an oil separator, from which oily substances are recovered, then to a two-cell, non-overflow stabilization lagoon system. The stabilization lagoons total approximately 2 acres in surface size and have never had a discharge. There is no evidence that groundwater contamination is a problem in this area, but this has not been investigated thoroughly .

Anaconda Aluminum Co., Columbia Falls

Waste sources at the Anaconda Aluminum plant include uncontaminated cooling water, disposed of with the treated sewage, as indicated in the Municipal Discharges section of this chapter. In addition, a sealed lagoon, 8 to 10 acres in size and located north of the aluminum plant, receives oils, acids, calcium fluoride wastes in an acid media, and other toxic wastes from the plant. No surface discharge from this lagoon occurs and most of the liquids are believed to evaporate. No groundwater testing programs have been attempted in this area to assess the effects of this disposal system on the subsurface waters. In addition, a ½ acre lagoon north of the plant receives the liquid wastes from the carbon paste plant. These wastes are very turbid, but are not toxic. Overflow from this lagoon occurs, but does not leave Anaconda Company property, and has no known deleterious effect on other uses.

Kalispell Meat Co.

This small slaughterhouse is located adjacent to Ashley Creek, south of Kalispell. Wastewaters from the plant include low volumes of washdown and cleaning waters. Such wastes are piped to small lagoons located between the plant and Ashley Creek. No surface discharge to Ashley Creek occurs from these waste stabilization ponds.

Characteristics of all industrial and municipal waste discharges to State waters in the basin are shown on Table 6.

MINING ACTIVITY

At the present time, there are no known producing mines in the upper Flathead drainage basin, with the exception of a number of gravel pit operations. The unmineralized pre-Cambrian geology which predominates in the drainage basin has left few mineral deposits worthy of extraction.

In the northern portions of the drainage basin, the pre-Cambrian argillite deposits are overlain with coal deposits in the vicinity of Coal Creek, in the North Fork Flathead drainage. These lignite deposits were mined to some extent in the past, but no active extraction has taken place, since

TABLE 6 CHARACTERISTICS OF MUNICIPAL & INDUSTRIAL DISCHARGES

WASTE SOURCE AND LOCATION (1)	WASTE SOURCE IDENTIFICATION DATA			DISCHARGE TYPE	DATES SAMPLED	DISCHARGE CHARACTERISTICS (3) (Units are mg/l unless otherwise shown)		
	TREATMENT TYPE	RECEIVING WATER	DISCHARGE PERMIT NO.					
Columbia Falls STP (2) (30N20W18CDD)	Aeration, settling tubes, filtration	Flathead River	MT-0020036	Continuous	Jan.-Dec. 1975	*Flow: 0.16 MGD* *BOD_5: 4* *TSS: 3.5*	*pH: 7.0-7.3 S.U.* *Fecal Coli: 46/100 ml* *NO_3-N: 59*	*PO_4-P: 11.6* *NH_4-N: 1.0* *Kjeldahl-N: 2.1* *Cl_2 Resid: 0.3*
Whitefish STP (2) (30N21W05BC)	Lagoon	Whitefish River	MT-0020184	Continuous	Feb. 1975-Jan. 1976	*Flow: 0.46 MGD* *BOD_5: 40* *TSS: 26*	*pH: 7.1-8.9 S.U.* *Fecal Coli: 736,000/100 ml* *NO_3-N: 0.20*	*PO_4-P: 7.4* *NH_4-N: 9.2* *Kjeldahl-N: 12.4*
Kalispell STP (2) (28N21W20CBB)	Oxidation towers and filtration	Ashley Creek	MT-0021938	Continuous	Jan.-Dec, 1975	*Flow: 1.3 MGD* *BOD_5: 29* *TSS: 16*	*pH: 6.7-8.3 S.U.* *Fecal Coli: 21/100 ml* *NO_3-N: 0.16*	*PO_4-P: 8.3* *NH_4-N: 17.1* *Kjeldahl-N: 18.6* *Cl_2Resid: 0.27*
Bigfork STP (2) (27N20W36BAD)	Trickling Filter	Swan River at mouth	MT-0020397	Continuous	*NUTRIENTS:* Dec.74-Mar.75 July-Oct. '75 *OTHERS:* Feb.-Dec.'75	*Flow: 91,000 gpd* *BOD_5: 34* *TSS: 29*	*pH: 6.9-7.2 S.U.* *Cl_2 Resid: 0.5* *NO_3-N: 2.3*	*PO_4-P: 8.9* *NH_4-N: 10.4* *Kjeldahl-N: 20.5*
Yellow Bay STP (2) (24N19W04AAA)	Extended Air + Coagulation + Sand Filter	Flathead Lake	MT-0023388	Seasonal	June-Oct. 1975	*Flow: 12,000 gpd* *BOD_5: 9* *TSS: 20*	*pH: 6.9-8.0 S.U.* *Fecal Coli: 67/100 ml* *NO_3-N: 0.20* *PO_4-P: 3.1*	*NH_4-N: 13.9* *Kjeldahl-N: 15.2* *Cl_2 Resid: 0*
Hungry Horse Dam STP (2) (30N19W22CDD)	Aeration plant	South Fork Flathead River	MT-0022578	Intermittent	Jan.-Sept. 1975 (4)	*Flow: 0.0032 MGD* *BOD_5: 10* *TSS: 8.8*	*pH: 6.2-7.9 S.U.* *Fecal Coli: 1150/100 ml*	

TABLE 6 Cont.

WASTE SOURCE AND LOCATION (1)	WASTE SOURCE IDENTIFICATION DATA			DISCHARGE TYPE	DATES SAMPLED	DISCHARGE CHARACTERISTICS (3) (Units are mg/l unless otherwise shown)
	TREATMENT TYPE	RECEIVING WATER	DISCHARGE PERMIT NO.			
Glacier Park-McDonald Lodge STP (2) 32N19W27AA	Trickling filter	Creek tributary to McDonald Lake	MT-0020109	Seasonal	July-Sept. 1975	*Flow: 0.040 MGD pH: 6.8-7.1 S.U.* *BOD_5: 60 Fecal Coli: 84,000/100 ml* *TSS: 32 Cl_2 Resid: 0.09*
Burlington Northern, Whitefish, Oil Facilities 31N22W36BAB	Chemical treatment Oil separation Lagoons	Whitefish River	MT-0000019	Continuous	Jan.-Dec. 1975	*Flow: 30,200 gpd TSS: 8.3* *Oil & grease: 4.7 pH: 6.0-7.7 S.U.*

Footnotes:

(1) See Appendix 3

(2) STP-Sewage Treatment Plant.

(3) Self-Monitoring Data supplied by discharging entity. Data are averaged from monthly reports for the time periods indicated.

(4) Data from quarterly reports only.

1942. The land is primarily under the ownership of the State of Montana and the U.S. Forest Service. The coal deposits are described as thin, lenticular beds of lignite with no appreciable coking qualities. Five coal seams range from 22 to 48 inches thick, but a sixth bed is 13½ feet thick. Other small coal deposits have been reported along Hay Creek in the North Fork Flathead drainage, and along the Flathead River 2 miles north of Coram (Ref. 33).

East of the Rocky Mountains, the Cutbank oil field has been very productive for both oil and gas for many years. Current thinking is that the massive Lewis Overthrust, which is clearly visible to the north from Marias Pass, and which formed the Rocky Mountains, may have overridden similar oil and gas-bearing sediments as far west as the North Fork Flathead River drainage. While these sediments would be at great depth, perhaps as much as three miles, oil companies have expressed interest in exploration for oil and gas in the North Fork Flathead drainage. At present, leases are being sought from the U.S. Forest Service and the Bureau of Land Management on some 236,000 acres of federal land in the North, Middle and South Forks of the Flathead drainage, with the greatest concentration of interest along the west side of the North Fork (Ref. 30, 31). While oil and gas exploration would, in the earlier stages, have little or no effect on water quality, the granting of exploration leases guarantees the exploring companies the right to develop any oil or gas encountered. Full scale development, if not properly controlled, could result in oil seeps to surface waters, sedimentation from road or pipeline construction and oil pollution from pipeline breakage or accidental spills. Any pipeline constructed up the North Fork would have to cross many streams.

In September, 1974, the Montana Department of Fish and Game (Ref. 25) brought public attention to a large coal mining proposal in the Canadian headwaters of the North Fork of the Flathead River, only eight miles upstream of the Montana border. Since that time, concern for the quality of the North Fork Flathead River has escalated from local concern to national, and now international concern. While the outcome of the Canadian proposal is not yet known, most authorities agree that the high quality coal will be extracted in the near future. The developer, Rio Algom, Ltd., has already expended millions of dollars in exploration of this Cabin Creek site. According to a Rio Algom briefing document, (Ref. 29) the Cabin Creek site will produce about 3 million tons of coal per year. Other developments may include construction of a 45-mile long railroad, a probable townsite near Cabin Creek of about 3000 population, improvements to the road system and construction of power and natural gas lines and a processing-plant. In addition, the improved access may open the way for development of phosphate and copper deposits in the headwaters of the North Fork (Ref. 34). The total Cabin Creek deposits would be about 66 million long tons of coal, making the mine life about 22 years. Other coal deposits are also known nearby, on the east side of the North Fork Flathead River. Water quality concerns associated with the Cabin Creek proposal are several-fold.

Acid mine drainage has sterilized streams in many locations in the U.S. in the past. The Rio Algom Co. maintains that acid drainage will not be a problem as the coal has a low sulphur content. Other water quality concerns which have not been properly addressed to date include erosion from seasonal runoff and from waters encountered in the mine, increase of sediment in the Flathead River due to construction of roads and railroads and stream channelization, discharge of sewage from the proposed townsite, and possible discharges from settling ponds or industrial processes. As the minimum low flow of record of the North Fork Flathead River at the Canada-Montana border is only 65 cfs, the stream has little dilution capacity for wastewaters. In response to the coal mining proposal, the Flathead Drainage 208 Project is currently monitoring water quality in the North Fork Flathead drainage (see Water Quality Section). Also the federal Canadian government has tabulated existing water quality data in the drainage north of the border (Ref. 28) and is proposing additional water quality monitoring for the future (Ref. 24). On the Montana side of the border, the Montana State legislature has appropriated $47,500 for a study of the North Fork Flathead (Ref. 26) to result in a report with recommendations to the state legislature. Other study proposals (Ref. 27) are currently unfunded, but with most existing water quality work to be terminated by late 1976, funding of a continuing study after that time is considered a necessity.

AGRICULTURAL DISCHARGES

Agricultural discharges are of lesser magnitude in the upper Flathead drainage than in downstream portions of the drainage. This is primarily due to the exclusive use of sprinkler irrigation or sub-irrigation, as opposed to flood irrigation. No known irrigation return flows exist in the upper Flathead drainage.

The primary water quality concern from agriculture is related to livestock access to small streams, resulting in trampled banks, loss of protective vegetation, erosion and manure runoff to the surface waters. The water quality results may include increased turbidity, sedimentation, bacterial contamination and with loss of vegetation, increased stream temperatures. In addition, nutrients from manure may cause algal blooms in downstream lakes or slow-moving streams.

Any livestock feedlots which have a potential waste discharge to state waters are required to obtain a confined livestock waste discharge permit from the Montana Department of Health and Environmental Sciences. Table 7 lists the feedlots in the upper Flathead drainage which currently have such permits. Several other feedlots, particularly hog feedlots, have permits pending.

HUNGRY HORSE DAM

Hungry Horse Dam, located near the town of Hungry Horse on the South Fork Flathead River, created a large reservoir which is some 500 feet deep at the dam. The discharge structure draws water from far below the reservoir surface, with the result that the South Fork below the dam is very much colder during summer months than the other forks of the Flathead River. The dam is operated with some environmental and recreational provisions, to the extent that some boating facilities are provided in the reservoir, the reservoir level is maintained as stable as possible during the summer, and minimum flows of 145 cfs are maintained below the dam. The structure was funded during wartime conditions, however, and environmental provisions and operational flexibility are generally lacking.

TABLE 7

AGRICULTURAL PERMITS IN FLATHEAD DRAINAGE ABOVE POLSON

NAME & ADDRESS	PERMIT NO.	BRIEF DESCRIPTION
Groves Swine Production (Donald Groves) Box 1606, Polson, MT 59860	F-11-S	An existing confined swine operation having capacity for 350 hogs.
Kenneth W. Smith Route 4, Kalispell, MT	F-16-H	An existing confined swine operation accommodating 80 head of swine.
Belton Livestock Co. Box 307, W. Glacier, MT	F-12-S	An existing confined swine operation with 6 sows and litters
Ron de Yong Swine Op. Route 5, Box 36A Kalispell, MT 59901	MT-0029020	An existing confined swine operation having capacity for 200 head of swine.
Kenneth W. Smith Route 4, Kalispell	MT-0029032	An expansion of his existing swine operation having total capacity for 700 head.
Fisher Bros. Hog Farm Route 1A, Box 47 Columbia Falls, MT	MT-0029037	An existing animal confinement facility having capacity for 600 head of swine.
Roger W. Nielson Route 1 Whitefish, MT	MT-0029043	A proposed confined swine operation having capacity for 40 sows with litters and 135 feeder pigs.
Mike Manning Swine Op. 291 Fairmont Road Kalispell, MT	MT-0029052	An existing animal confinement facility having capacity for 800 head of swine.

One result is that large surges of very cold water are commonplace in the lower reaches of the Flathead River. These surges, as well as the normal daily discharge of cold water, affect the biota of the lower river. Stanford (Ref. 7) studied the stoneflies of the Flathead drainage. He concluded that these important fish food organisms were adversely affected both in rate of growth and in ability to hatch and reproduce, by the cold discharges from Hungry Horse Dam. Migratory fishes, such as kokanee, cutthroat and Dolly Varden, key on both flow and water temperature to trigger their upstream annual migrations. Artificially induced temperature variations have been observed to confuse these runs, and flow fluctuations have left spawning redds to dry along the shoreline. Additional studies are needed to assess these effects on the fisheries of the Flathead River. Possible partial solutions to the temperature and flow problems include operational changes at Hungry Horse Dam, installation of a variable-level intake structure and construction of a downstream re-regulation dam.

Hungry Horse Dam may also be having effects on downstream Flathead Lake. Tibbs (Ref. 9) suggested that seasonal sediment loading may be important in settling nutrients and algae to the bottom of Flathead Lake, thus controlling nuisance algal problems in the lake. Hungry Horse Dam settles natural sediments in the reservoir prior to reaching Flathead Lake, and may thus contribute to eventual eutrophication of the lake.

In addition, recreational problems are annually encountered along Hungry Horse Reservoir, as the annual drawdown makes boat access difficult or impossible seasonally. These problems are recognized and have been studied to some extent by the Bureau of Reclamation (Ref. 23) which built and now operates the dam. The hydrologic effects of the dam are shown on Figure 2 (Ref. 38).

NON-POINT SOURCES

A number of non-point water pollution sources contribute sediment, nutrients and bacteria to waters in the upper Flathead drainage. Tibbs (Ref. 9) calculated that only 11% of the phosphates entering Flathead Lake can be assigned to the point discharges (sewage plants) in the drainage. After an additional year of nutrient data gathering, this figure is now revised to about 5% of the total. The other 95% of the algae-stimulating nutrients originate from non-point sources such as livestock activities, logging and road-building operations, agricultural fertilization, and a myriad of other poorly defined sources.

Seasonal Natural Runoff

Seasonal natural runoff annually accounts for the greatest portion of sediments in the Flathead drainage, and probably accounts for much of the non-point nutrient loading as well. Man's activities often aggravate natural sediment loads by increasing stream velocities (stream channelization) by encouraging slides and erosion (improper road construction and poor land management) and by leaving large tracts of land barren to seasonal runoff (logging clearcuts, plowed fields, mining activity). The Middle Fork Flathead River carries particularly heavy seasonal loads of sediment, due largely to landslides and old damage from the 1964 flood.

FIGURE 2

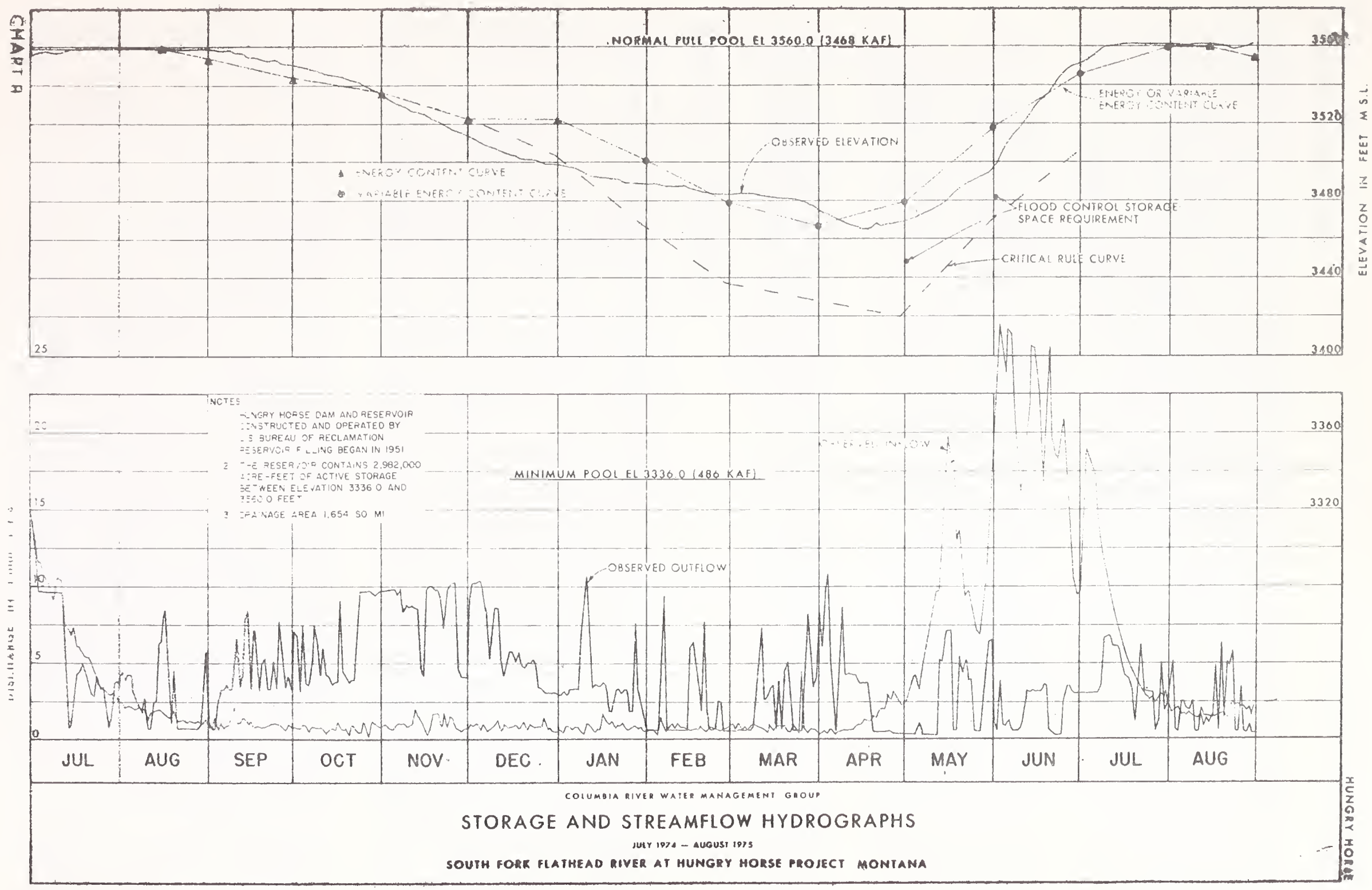


CHART B
NORMAL FULL POOL EL 3560.0 (3468 KAF)
ENERGY CONTENT CURVE
VARIABLE ENERGY CONTENT CURVE
OBSERVED ELEVATION
ENERGY OR VARIABLE ENERGY CONTENT CURVE
FLOOD CONTROL STORAGE SPACE REQUIREMENT
CRITICAL RULE CURVE
ELEVATION IN FEET M.S.L.
3520
3480
3440
3400
25
20
15
10
5
0
3360
3320
NOTES
1 HUNGRY HORSE DAM AND RESERVOIR CONSTRUCTED AND OPERATED BY U.S. BUREAU OF RECLAMATION RESERVOIR FILLING BEGAN IN 1951
2 THE RESERVOIR CONTAINS 2,982,000 ACRE-FEET OF ACTIVE STORAGE BETWEEN ELEVATION 3336.0 AND 3560.0 FEET
3 DRAINAGE AREA 1,654 SQ MI
MINIMUM POOL EL 3336.0 (486 KAF)
OBSERVED OUTFLOW
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
COLUMBIA RIVER WATER MANAGEMENT GROUP
STORAGE AND STREAMFLOW HYDROGRAPHS
JULY 1974 — AUGUST 1975
SOUTH FORK FLATHEAD RIVER AT HUNGRY HORSE PROJECT MONTANA
HUNGRY HORSE

Logging Operations

Logging operations have long been blamed for causing stream sedimentation, temperature increases, organic color and nutrient loading in downstream waters. There is little doubt that careless logging operations can cause all these problems in serious proportions. However, it is also becoming clear that careful logging and road building operations can greatly reduce adverse effects on water quality. Of primary importance is keeping heavy equipment out of streams and leaving green strip setbacks along all flowing streams. Road construction should be tailored to soil conditions whenever possible as well.

The Flathead Drainage 208 Project is currently undertaking a forest practices study which, in part, will assess the sedimentation potential of several watersheds proposed for timber harvest. In addition, the State Department of Health and Environmental Sciences is in the second year of water quality studies for the U. S. Forest Service in the Tally Lake drainage northwest of Kalispell (Ref. 22). Data from this study will be used to help develop a computer program to predict water quality effects in areas proposed for logging.

The U.S. Forest Service controls most of the land in the basin managed for timber harvest and on these lands federal logging standards are established and enforced by the Forest Service. The state has jurisdiction when water quality standards are violated.

Waterfront Subdivisions

Land subdivisions, accompanied by clearing, development and influx of concentrated populations along shorelines of lakes and streams, can cause water quality problems. Most often, such problems are related to improper sewage disposal which results in bacteriological, organic and nutrient pollution in the adjacent waters. Such problems are most pronounced where the soils are too "tight" or rocky, the ground is too steep, or the sewage disposal system is located in a flood plain or high groundwater area. Under present laws, the State Department of Health and Environmental Sciences must approve all subdivisions with lots of 20 acres and less, prior to filing or sale. Such approval must include a technical review to assure that each lot has enough suitable ground to provide for proper sewage disposal. The actual construction on the lot falls under the jurisdiction of the county sanitarian's office.

Lakes are particularly sensitive to shoreline development. While it is uniquely difficult to prove a cause-and-effect relationship between algal problems (eutrophication) and shoreline development, the effects are quite graphic. Sonstelie (Ref. 8) in his study of twelve lakes in the drainage, listed seven as eutrophic, and the remaining five as less-productive. Of the seven with problems, six are relatively small and have considerable shoreline development (Blaine , Echo, Five, Foy, Mary Ronan, Rogers) and the seventh (Lower Stillwater) is suffering effects of past log mill discharges. The remaining five good quality lakes (Blanchard, Whitefish, Ashley, Little Bitterroot, Swan) are either large enough to support considerable development, or are deep and cold, reducing productivity. Most small lakes in the basin, with heavy shoreline development, are having algal problems, even though it might not be possible to show any septic tank malfunctions along the shoreline.

Chemical Applications

Pesticide or fertilizer applications are not well documented. Pesticide application is now controlled through licensing of applicators by the state. No known pesticide problems are known in the basin. Fertilizer application is now largely controlled by economics. Fertilizers have become so expensive that few farmers can afford to apply them in a careless manner. Without doubt, portions of any application of fertilizers or pesticides will eventually find their way to surface waters, but while the situation is very poorly documented, no problem areas are known to exist.

VII. SURFACE WATER RESOURCES

The Upper Flathead Drainage basin includes several discrete drainages, broken down for the purposes of this report into three segments. These are the main Flathead River drainage, the Swan drainage and the lower valley drainages. The Flathead drainage includes the main fork Flathead River and its three near-equal forks, the North Fork, Middle Fork and South Fork Flathead River. This drainage is tributary directly to Flathead Lake and comprises an average annual flow of about 10,000 cfs. The Swan drainage is a separate basin draining northerly, directly into the Flathead Lake near Bigfork. Average annual flow figures indicate that the Swan River is approximately forty percent as large as any one of the three main forks of the Flathead River. The lower valley drainages comprise the Stillwater and Whitefish Rivers, which join before entering the Flathead River near Kalispell, and Ashley Creek, tributary to the Flathead River below Kalispell. In contrast to the fast flowing streams mentioned above, the lower valley drainages are quite slow moving, with flat gradients and are more heavily used for agricultural purposes. The combined average annual streamflow of these three streams is approximately 600 cfs. Flathead Lake forms the downstream terminus of the drainage basin as defined for this report. The entire basins's flow is measured at the Flathead River near Polson, where average annual flow rate is 11,800 cfs.

The U.S. Geological Survey has operated 15 streamflow gaging stations in the upper Flathead drainage basin (plate 1). The USGS data for gaging stations in the basin are summarized in Table 8.

Streamflows in the upper Flathead drainage basin are affected by local weather conditions, geology, reservoir and dam operation, and irrigation (Table 9). The major part of the flow occurs during the spring runoff. However, spring runoff is a function of weather and precipitation and may be quite variable in time and volume of runoff. May, June and early July are commonly the months during which the spring runoff occurs in the upper Flathead basin. However, warm weather in mid-winter occasionally produces significant heavy runoffs as early as January. Regulation at reservoirs and power generating sites have, in the past, caused considerable variations in downstream river flows in some areas. For example, minimum recorded flow below Hungry Horse Dam is only 7 cfs, which is abnormal and far below the 3583 cfs average annual flow. This low flow occurred when the upstream dam was being filled. Since 1954, Hungry Horse Dam low flows have been maintained above 145 cfs, in accord with an agreement with the Fish & Game Department.

Irrigation withdrawals have a substantial effect on some of the lower valley streams, including the Whitefish and Stillwater Rivers and Ashley Creek. Flood irrigation is not practiced to any significant extent in the basin, and so irrigation return flows do not cause the usual water quality problems associated with agriculture. Sprinkler irrigation or natural sub-irrigation accounts for most agricultural use in the drainage. There are no significant irrigation impoundments in the upper Flathead drainage.

The three large dams in the study area, including Hungry Horse Dam, Kerr Dam and the much smaller Swan Dam at Bigfork, are all principally power generating sites, the two larger dams also providing flood protection. In addition, three new dams have been proposed for the Flathead drainage, with one site on the Middle Fork Flathead River, and two alternate sites on the North Fork Flathead River. All are presently considered unfeasible, either for economic reasons, or due to park, wilderness or wild and scenic area designations. At present, the North and Middle Forks of the Flathead River are free-flowing streams.

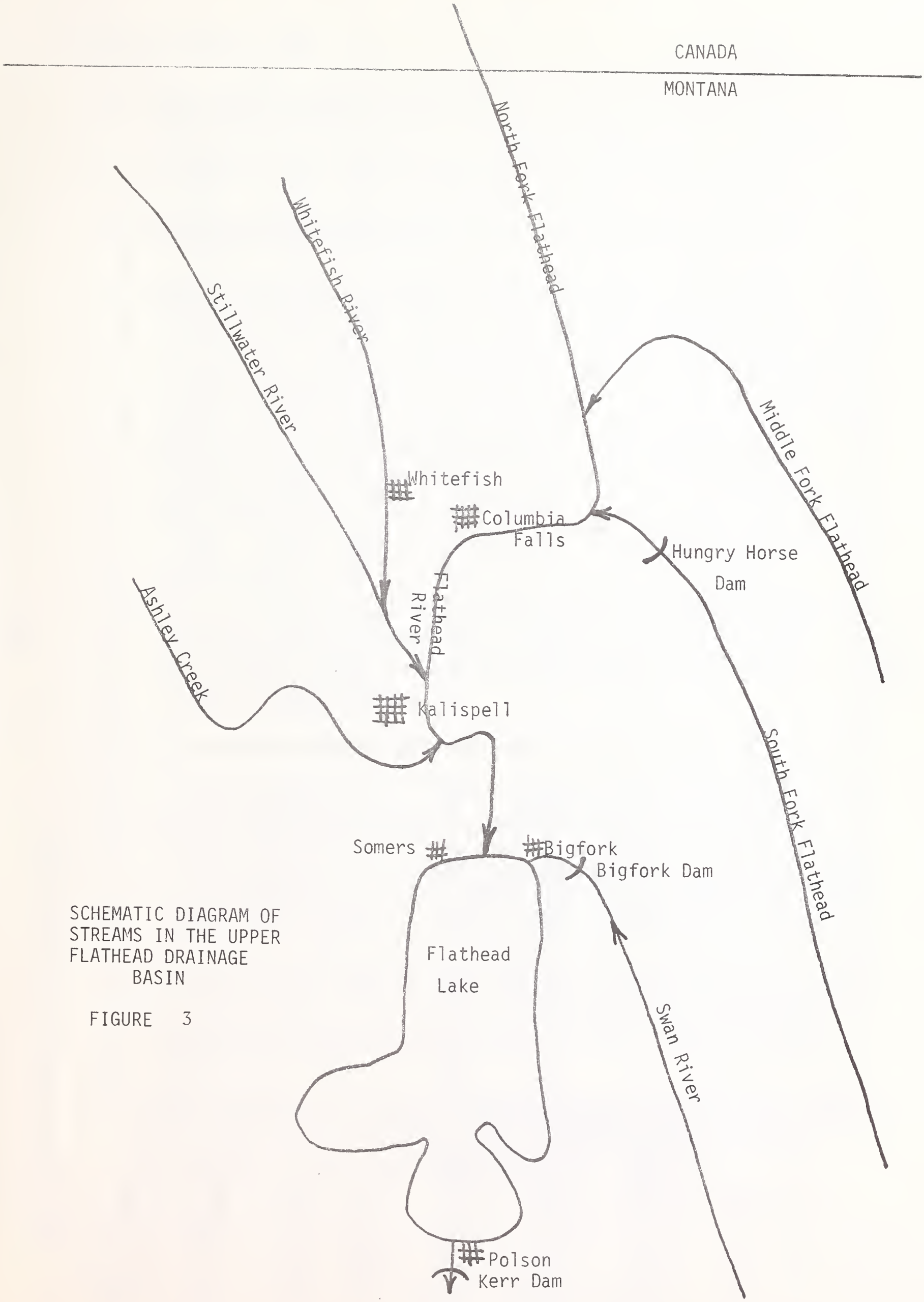
The attached schematic diagram shows the primary streams in the drainage basin, as well as the principal dam sites and town sites.

TABLE 8 SUMMARY OF U.S. GEOLOGICAL SURVEY STREAMFLOW GAGING STATION DATA

STATION NAME	USGS STATION NO.	LOCATION[1]	EXTREME RECORD FLOW (cfs) INSTANTANEOUS MINIMUM	EXTREME RECORD FLOW (cfs) MAXIMUM	DRAINAGE AREA (Sq.Mi.)	ANNUAL AVERAGE FLOW (cfs)	PERIOD OF RECORD
Flathead River at Flathead, B.C.	12355000	Lat.49°00'04" Long.114°28'30"	65	16,300	427	992	1929-Present
North Fork Flathead River near Columbia Falls, MT	12355500	32N20W35BCA	198	69,100	1,548	3,023	1910-1917 1929-1935 Partial 1935-Present
Middle Fork Flathead River near West Glacier, MT	12358500	32N19W34AC	173	140,000	1,128	2,971	1939-Present
South Fork Flathead River above Twin Creek near Hungry Horse, MT	12359800	26N16W36ABA	156	50,900	1,160	2,429	1964-Present
Sullivan Creek near Hungry Horse, MT	12361000	26N17W12CB	10	5,020	71	225	1948-1956 1959-Present
South Fork Flathead River near Columbia Falls, MT	12362500	30N19W16CDC	7	46,200	1,663	3,583	1910-1925 Partial 1927-Present
Flathead River at Columbia Falls, MT	12363000	30N20W17DBB	798	176,000	4,464	9,814	1922-1923 Partial 1928-Present
Flathead River near Polson, MT	12372000	22N21W11DAC	5	110,000	7,096	11,800	1907-Present

TABLE 8 Cont. SUMMARY OF U.S. GEOLOGICAL SURVEY STREAMFLOW GAGING STATION DATA

STATION NAME	USGS STATION NO.	LOCATION(1)	EXTREME RECORD FLOW (cfs) INSTANTANEOUS MINIMUM	MAXIMUM	DRAINAGE AREA (Sq.Mi.)	ANNUAL AVERAGE FLOW (cfs)	PERIOD OF RECORD
Stillwater River at Olney, MT	12363920	32N23W18DAD	25	1,740	146	---	1972-Present
Stillwater River near Whitefish, MT	12365000	30N22W34CA	40	4,330	524	343	1930-1950 1972-Present
Swift Creek near Whitefish, MT	12365800	31N22W05BDA	11	1,980	78	---	1972-Present
Whitefish River near Kalispell, MT	12366000	30N21W34BDC	4.5	1,580	170	193	1928-1950 1972-Present
Ashley Creek near Kalispell, MT	12367500	28N22W32B, Center	2.4	203	195	31	1931-1950 1969-1970 1972-1974
Swan River near Condon, MT	12369200	19N16W08B, Center	22	1,540	73	---	1972-Present
Swan River near Bigfork, MT	12370000	26N19W11CC	193	8,890	671	1163	1910-1911 1922-Present



SCHEMATIC DIAGRAM OF STREAMS IN THE UPPER FLATHEAD DRAINAGE BASIN

FIGURE 3

TABLE 9

TYPICAL STREAM FLOW DATA FOR UPPER FLATHEAD DRAINAGE BASIN

Monthly Mean Discharge (cfs) for Water Year October 1973 to September 1974

STATION NAME	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	TOTAL FOR YR. (1000 ACRE-FT)	AVG. YR. (1000 ACRE-FT)
orth Fork Flathead iver near Columbia alls	791	1794	1228	2131	1213	1084	4733	11430	20780	7642	2478	1327	3,417	2,190
Middle Fork Flathead iver near West lacier	560	1587	1188	2420	1165	933	3933	8770	18460	6832	2052	954	2,947	2,152
outh Fork Flathead iver near Columbia alls (1)	4075	2334	844	4603	6788	7764	10970	2951	2605	5385	2186	4094	3,721	2,596
tillwater River near hitefish, MT	74	112	94	199	180	165	971	1928	1916	634	232	142	401	248
hitefish River near alispell, MT	46	70	105	135	141	120	357	685	1194	695	183	107	231	140
wan River near igfork, MT	397	648	625	950	734	762	2283	2664	5803	2968	1047	680	1,180	843
lathead River near olson, MT (1)	6695	7459	8701	11080	13990	16090	19300	26480	44130	25070	8618	6324	12,160	8,549

1) This station affected by upstream dam(s).

VIII. WATER QUALITY

Water quality in the Upper Flathead drainage basin is generally quite good, although some streams and lakes in the more populated portions of the drainage have rather poor quality water. Municipal discharges cause problems of considerable magnitude in two streams, Ashley Creek and Whitefish River. Agricultural dewatering contributes to water quality problems in the Stillwater and Whitefish Rivers. Natural seasonal sediment loads cause seasonal turbidity problems in most streams.

Many water quality sampling stations have been established and used by a number of agencies, institutions and individuals in the Upper Flathead drainage. Fifteen pages of sampling stations are documented in this chapter, with information given on location, sampling entity, period of record, sampling interval and parameters measured. With the exception of student sampling efforts for various institutions, all known sampling stations in the basin are listed. The Environmental Protection Agency, between October 1974 and October 1975 conducted some lake sampling by pontooned helicopter on Flathead, Swan, Whitefish, Mary Ronan, Tally and McDonald Lakes. These stations are not specifically known, and are not listed, although many stream stations sampled by the National Guard for the same program are shown on the tables. Most of the stations shown were monitored for relatively short periods of time, or for relatively few parameters.

For the purpose of more detailed discussion, the drainage basin is broken in seven segments, including Flathead drainage above Hungry Horse, Flathead River from Columbia Falls to Flathead Lake, Whitefish River, Stillwater River, Ashley Creek, Swan River and Flathead Lake.

Flathead Drainage above Hungry Horse

The water quality of the North and Middle Forks of the Flathead River is presently very good. The North Fork carries about twice as much phosphorus as the Middle Fork, probably reflecting the greater logging activity there (see phosphorus budget later in this chapter). Canadian coal mining plans and oil exploration on the Montana side of the border could have a considerable effect on the water quality of the North Fork Flathead River. This is discussed in some detail in Chapter VI under "Mining Activity".

The Middle Fork Flathead River carries considerable seasonal sediment loads. This is partially aggravated by damage incurred in the record 1964 flood, and is also aggravated by occasional washouts of channelized portions of streams along U.S. Highway 2, particularly along Bear Creek.

This segment of the drainage has received only one treated sewage discharge, to Lake McDonald from Lake McDonald Lodge. This discharge has recently been eliminated, with all wastewaters transported to Apgar for treatment and land disposal.

Flathead River from Columbia Falls to Flathead Lake

The dominating water quality effect in this segment is the temperature fluctuations caused by cold releases from Hungry Horse Reservoir. Flow fluctuations from Hungry Horse Dam also cause problems. These problems and potential solutions are discussed in Chapter VI, under "Hungry Horse Dam".

As discussed later in this chapter, some 55% of the total phosphorus loadings flowing into Flathead Lake originate in this segment, excluding sewage plant loadings which are included in the other 45%. Only one conceivable source of nutrients could produce such loadings, that being the runoff from livestock facilities and from fertilized fields.

Whitefish River

The Whitefish River receives the treated sewage effluent from the city of Whitefish. This discharge has been shown to have a substantial effect on the nutrients and bacteriological quality of the stream as far downstream as Glacier International Airport. The stream has a low gradient and relatively low summer flows, and therefore has little capacity for stabilizing wastewaters.

The city of Whitefish sewage discharge accounts for only about ¼ of the phosphorus carried by the stream, hence other sources are present. Agricultural activities and headwaters logging activity may contribute phosphorus to the stream, with logging thought to be much the lesser of the two sources. Seasonal erosion doubtless contributes phosphorus in significant proportions during May and June.

With relatively low flows in the Whitefish River, ammonia toxicity from the sewage plant must be considered. Discharge monitoring data (from Chapter VI), indicates that the average ammonium concentration is 9.2 mg/l as N, and the average sewage plant discharge is 0.46 MGD. Thus, the average daily ammonia contribution to the Whitefish iiver is 35 lbs. NH_4-N. The only flow data available is near the international airport, where the minimum flows are about 40 cfs. Thus the NH_4-N concentration in the Whitefish River is about 0.16 mg/l during critical low flow periods. Whitefish River pH ranges as high as 8.5 with temperatures of approximately 22°C. Under such conditions, the toxic, un-ionized ammonia would be approximately 13% of the total ammonium or about 0.02 mg/l as N in the River. Such levels are at maximum recommended EPA concentrations and while problems should not be evident at present, the situation bears close watching. The above analysis is based on the best available data for ammonium and 1 year's monthly stream sampling, by the State, at a downstream station.

Stillwater River

While the Stillwater River receives no known point waste discharges, its flat gradient and seasonal low flows limit its capacity to stabilize organic wastes. The greatest problem the Stillwater faces is the very rapid increase of agricultural withdrawals both directly from the river and from nearby groundwater. The Montana Department of Fish & Game has documented that low summer flows already present physical barriers to fish migration across some riffles. Serious

water quality problems have not been documented in the lower Stillwater River, although little sampling has been done there. Seasonal high temperatures may be a problem. Fall kokanee runs appear to be making a limited comeback in the Stillwater River.

Ashley Creek

The dominating water quality factor in Ashley Creek is the discharge of the Kalispell Sewage Treatment plant. Dilution, at least seasonally, is low enough that nutrients are a serious problem. This is discussed later in this chapter, under the nutrient budget section. In addition, ammonia toxicity may at least seasonally be a problem. Accurate flow data are not available for Ashley Creek at the sewage plant, as the U.S. flow gaging station is some 6 miles upstream. However, using summer low flow data from that station as well as waste discharge data shown in Section VI of this report, it is estimated that NH_4-N concentrations in Ashley Creek below the sewage plant may be about 3.4 mg/l during critical flow periods. Ashley Creek pH levels may approach 8.1, and water temperatures have been recorded as high as 19°C. Under such conditions, about 4.5% of the ammonium would be un-ionized ammonia. Thus NH_3-N could approach 0.15 mg/l in Ashley Creek. This is about seven times as high as EPA recommended limits.

Ashley Creek above the Kalispell sewage plant is far from pristine. Heavy development and livestock use of the stream banks, and over-appropriation of water rights for irrigation, contribute to making this low gradient stream also a low quality stream. Upstream, the warming effects of Smith Lake reduce the quality of Ashley Creek as a fishery, although the stream does support a trout population above Kalispell. Trout and salmon runs are presently blocked from entering Ashley Creek, at least seasonally, by impaired water quality. While the situation will improve somewhat as the operation of the Kalispell sewage plant reaches design efficiency, the nutrients will probably remain sufficient to cause algal blooms in the lower stream and there will be attendant oxygen blocks. The best long range solution for Ashley Creek would be to remove the Kalispell sewage discharge from the stream completely.

Lower Ashley Creek is presently classifed as E-F water, with no provisions for fish life. Water quality standards are not in violation relative to ammonia, and a waste load allocation will not be attempted. It is recognized, however, that ammonia levels pose a threat to fish life in lower Ashley Creek.

Swan River

The water quality of the relatively undeveloped Swan River drainage is very good. In spite of moderate to heavy logging activity, nutrient production is low. The waters are cool and usually clear. Subdivision activity between Swan Lake and Bigfork is resulting in occasional positive bacteriological tests there. The water is still of adequate quality that the town of Bigfork derives its water supply directly from the river, utilizing only simple chlorination for treatment. The fisheryof the stream is seriously affected by a low head dam above Bigfork, although a fish ladder was added after the dam was placed in operation.

Flathead Lake

As discussed earlier, algal growths of nuisance proportions have been documented in isolated portions of Flathead Lake, and the problem seems to be increasing. While subdivision and construction along the shoreline of the lake has proliferated in recent years, this is not thought to be the source of the algal blooms except in some isolated bays where interchange with the main lake is at a minimum. A nutrient study of the lake concluded that sufficient phosphates are entering via the Flathead River to cause serious algal problems, but that much of this phosphate load is being more or less permanently tied up in bottom sediment as spring runoff sediments settle.

The water quality of Flathead Lake is still quite excellent. Many private water supplies use water directly from the lake. The community of Somers uses lake water with simple chlorination as its sole source of water. The north half of Flathead Lake seasonally becomes quite turbid during years of heavy runoff.

Smaller Lakes in the Flathead Drainage

Studies of smaller lakes in the basin (Ref. 8) have shown problems to exist in several areas. The defined problem areas are listed below:

Lake Mary Ronan-logging, cattle grazing and subdivision development have combined to make this an increasingly eutrophic lake, and one which supports heavy algal blooms seasonally. The fine trout and kokanee fishing found there are considered threatened, by the Montana Dept. of Fish & Game. Marked diurnal oxygen fluctuations have been observed in the lake.

Echo Lake-heavy subdivision and cattle grazing activity, in tandem with serious hydrological fluctuations, have resulted in very heavy seasonal algal blooms. These blooms limit the heavy recreational use of the lake, making it unpleasant to swim and somewhat difficult to fish. Some 41 cabins surround the lake, 200 to 250 cattle are grazed nearby, and over 3000 acres of the watershed have been heavily logged.

Foy Lake-a diverted tributary stream apparently is the cause of the dropping water levels and increasing dissolved salt concentrations of this heavily used lake. Water quality limits the age of trout in this lake. One possible solution would be the addition of water from an outside source, perhaps Ashley Creek.

Lower Stillwater Lake-in years past, a log mill operation deposited thick wood product sediments in the north end of this lake. Lower water strata still are anaerobic from these slowly decomposing organic sediments, and fish migration up the tributary river may be seasonally limited. The volume of sawdust slurry on the lake bottom has been estimated at 107 acre feet.

TABLE 10

UPPER FLATHEAD DRAINAGE BASIN WATER QUALITY SUMMARY

Flow-cubic feet per second	Magnesium-Mg mg/1	Chloride-Cl mg/1	Fecal Coliforms/100 ml	TR Lead-Pb mg/1
Temperature-^{o}C	Sodium-Na mg/1	Fluoride-F mg/1	(2) TR Cadmium-Cd mg/1	Dissolved Oxygen-mg/1
Turbidity-Jackson Turbidity Units	Potassium-K mg/1	Nitrate-NO_3 mg/1	TR Zinc-ZN mg/1	Total Suspended Solids
Specific Conductance-umho/cm at 25° C	Bicarbonate-HCO_3 mg/1	Total Phosphorus-PO_4 mg/1	TR Arsenic-As μg/1	
pH-S.U.	Carbonate-CO_3 mg/1	BOD_5-mg/1	TR Iron-Fe mg/1	
Calcium-Ca mg/1	Sulfate-SO_4 mg/1	Total Coliforms/100 ml	TR Copper-Cu mg/1	

SAMPLING STATION DESIGNATION	SAMPLING LOCATION	DATE SAMPLED						
N. Fork Flathead River near Columbia Falls SDH&ES KWQB #13	32N20W35BCA	6/12/73	Flow	8280	HCO_3	87	F.Coliform	2
			Temp.	8.0	CO_3	0	Cd	---
			Turbidity	9.3	SO_4	3.5	Zn	---
			S. Conductance	142	Cl	0.1	As	---
			pH	8.16	F	---	Fe	---
			Ca	22	NO_3	0.31	Cu	---
			Mg	5.0	PO_4	0.08	Pb	---
			Na	0.8	BOD_5	3.4	DO	11.4
			K	---	T.Coliform	70	TSS	48.4
Same Station	"	9/17/73	Flow	715	HCO_3	130	F.Coliform	0
			Temp.	7.2	CO_3	5	Cd	<0.01
			Turbidity	0.18	SO_4	13.0	Zn	<0.01
			S.Conductance	260	Cl	0.3	As	<0.01
			pH	8.34	F	---	Fe	<0.01
			Ca	32	NO_3	0.00	Cu	<0.01
			Mg	7.6	PO_4	0.03	Pb	<0.01
			Na	1.0	BOD_5	1.4	DO	10.9
			K	---	T.Coliform	11	TSS	0.27

(1) Concentrations are in milligrams per liter unless otherwise indicated.

(2) TR-Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

TABLE 10

UPPER FLATHEAD DRAINAGE BASIN WATER QUALITY SUMMARY (Cont.)

SAMPLING STATION DESIGNATION	SAMPLING LOCATION	DATE SAMPLED						
M. Fork Flathead River near West Glacier SDH&ES, KWQB #14	32N19W34ACC	6/12/73	Flow	7670	HCO_3	81	F.Coliform	3
			Temp.	7.5	CO_3	0	Cd	---
			Turbidity	8.4	SO_4	3.5	Zn	---
			S.Conductance	150	Cl	0.2	As	---
			pH	7.22	F	---	Fe	---
			Ca	20	NO_3	0.66	Cu	---
			Mg	5.8	PO_4	<0.03	Pb	---
			Na	0.8	BOD_5	2.5	DO	10.6
			K	---	T.Coliform	6	TSS.	42.0
Same as above	"	9/17/73	Flow	510	HCO_3	132	F.Coliform	2
			Temp.	7.6	CO_3	0	Cd	<0.01
			Turbidity	0.17	SO_4	9.3	Zn	<0.01
			S.Conductance	197	Cl	0.1	As	<0.01
			pH	7.96	F	---	Fe	<0.01
			Ca	28	NO_3	0.49	Cu	<0.01
			Mg	6.4	PO_4	0.03	Pb	<0.01
			Na	1.2	BOD_5	1.5	DO	10.4
			K	---	T.Coliform	20	TSS.	0.53
S. Fork Flathead River below Hungry Horse Dam KWQB #15, SDH&ES	30N19W27CDC	6/12/73	Flow	156	HCO_3	107	F.Coliform	0
			Temp.	5.0	CO_3	0	Cd	---
			Turbidity	3.3	SO_4	---	Zn	---
			S.Conductance	171	Cl	0.2	As	---
			pH.	8.20	F.	---	Fe	---
			Ca	24	NO_3.	0.29	Cu	---
			Mg	6.6	PO_4.	<0.03	Pb	---
			Na	0.7	BOD_5	4.2	DO	12.7
			K.	---	T.Coliform	1	TSS.	3.0

Concentrations are in milligrams per liter unless otherwise indicated

TR-Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

TABLE 10

UPPER FLATHEAD DRAINAGE BASIN WATER QUALITY SUMMARY (Cont.)

SAMPLING STATION DESIGNATION	SAMPLING LOCATION	DATE SAMPLED						
S. Fork Flathead River below Hungry Horse Dam SDH&ES KWQB #15	30N19W27CDC	9/17/73	Flow	163	HCO_3	88	F.Coliform	0
			Temp.	4.4	CO_3	0	Cd	<0.01
			Turbidity	0.57	SO_4	7.5	Zn	<0.01
			S.Conductance	150	Cl	0.2	As	<0.01
			pH	7.4	F	---	Fe	<0.01
			Ca	23	NO_3	0.22	Cu	<0.01
			Mg	4.3	PO_4	0.03	Pb	<0.01
			Na	0.6	BOD_5	2.8	DO	11.5
			K	---	T.Coliform	252	TSS	1.8
Flathead River at Columbia Falls SDH&ES KWQB #16	30N20W17DBB	6/12/73	Flow	17,000	HCO_3	85	F.Coliform	2
			Temp.	9.0	CO_3	0	Cd	---
			Turbidity	75	SO_4	3.2	Zn	---
			S.Conductance	145	Cl	0.2	As	---
			pH	8.26	F	---	Fe	---
			Ca	20.0	NO_3	0.53	Cu	---
			Mg	5.0	PO_4	0.07	Pb	---
			Na	0.8	BOD_5	1.8	DO	10.0
			K	---	T.Coliform	20	TSS	56
Same as above station	"	9/17/73	Flow	1,560	HCO_3	116	F.Coliform	1
			Temp.	8.3	CO_3	0	Cd	<0.01
			Turbidity	0.38	SO_4	8.8	Zn	<0.01
			S.Conductance	199	Cl	0.8	As	<0.01
			pH.	8.54	F.	---	Fe	<0.01
			Ca	29	NO_3.	0.22	Cu	<0.01
			Mg	8.1	PO_4.	<0.03	Pb	<0.01
			Na	1.1	BOD_5	1.8	DO	10.6
			K.	---	T.Coliform	134	TSS	1.2

[1] Concentrations are in milligrams per liter unless otherwise indicated

[2] TR-Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

TABLE 10

UPPER FLATHEAD DRAINAGE BASIN WATER QUALITY SUMMARY (Cont.)

SAMPLING STATION DESIGNATION	SAMPLING LOCATION	DATE SAMPLED						
Ashley Creek near Kalispell U. S. Geological Survey Station #12367500 (above sewage plant)	28N22W29BAA	Several samples 1968-1970	Flow	30.8	HCO_3	71	F.Coliform	12
			Temp.	9.0	CO_3	73	Cd	---
			Turbidity	6.2	SO_4	10.0	Zn	---
			S.Conductance	263	Cl	1.66	As	---
			pH	7.7	F	---	Fe	---
			Ca	44	NO_3	0.20	Cu	---
			Mg	---	PO_4	0.24	Pb	---
			Na	3.60	BOD_5	2.02	DO	8.6
			K	1.42	T.Coliform	2248	TSS	---
Ashley Creek below Kalispell, U.S. Geological Survey Station #12367800 (before sewage plant upgrading)	28N21W33BCC	Several samples 1968-1970	Flow	37	HCO_3	---	F.Coliform	265
			Temp.	13.6	CO_3	---	Cd	---
			Turbidity	11.9	SO_4	11.75	Zn	---
			S.Conductance	359	Cl	4.26	As	---
			pH	7.4	F	---	Fe	---
			Ca	45	NO_3	0.61	Cu	---
			Mg	---	PO_4	2.67	Pb	---
			Na	7.0	BOD_5	4.98	DO	4.90
			K	1.95	T.Coliform	60,500	TSS	---
Flathead River near Bigfork U.S. Geological Survey Station #12369000	27N20W22AA	Numerous samples 1969-1971	Flow	10,653	HCO_3	50	F.Coliform	5
			Temp.	6.07	CO_3	28	Cd	0.000
			Turbidity	9.5	SO_4	6.94	Zn	0.026
			S.Conductance	181	Cl	0.66	As	1.5
			pH.	7.4	F.	0.108	Fe	0.019
			Ca	27.8	NO_3.	0.32	Cu	0.022
			Mg	3.21	PO_4.	0.20	Pb	0.003
			Na	1.29	BOD_5	0.74	DO	10.8
			K.	0.50	T.Coliform	1990	TSS	---

[1] Concentrations are in milligrams per liter unless otherwise indicated

[2] TR-Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

TABLE 10

UPPER FLATHEAD DRAINAGE BASIN WATER QUALITY SUMMARY (Cont.)

SAMPLING STATION DESIGNATION	SAMPLING LOCATION	DATE SAMPLED						
Swan River near Bigfork SDH&ES KWQB #17	26N19W11BAD	6/19/73	Flow	2880	HCO_3	99	F.Coliform	0
			Temp.	12.2	CO_3	---	Cd	---
			Turbidity	0.8	SO_4	2.3	Zn	---
			S.Conductance	150	Cl	0.2	As	---
			pH	8.16	F	---	Fe	---
			Ca	26	NO_3	0.11	Cu	---
			Mg	3.8	PO_4	<0.03	Pb	---
			Na	0.9	BOD_5	1.6	DO	9.5
			K	---	T.Coliform	68	TSS	0.7
Same as above station	"	9/5/73	Flow	384	HCO_3	104	F.Coliform	0
			Temp.	17.0	CO_3	1.0	Cd	<0.01
			Turbidity	0.38	SO_4	4.5	Zn	<0.01
			S.Conductance	170	Cl	0.4	As	<0.01
			pH	8.33	F	---	Fe	<0.01
			Ca	26	NO_3	0.09	Cu	<0.01
			Mg	4.3	PO_4	<0.03	Pb	<0.01
			Na	1.0	BOD_5	0.4	DO	9.00
			K	---	T.Coliform	111	TSS	3.4
Whitefish River near Kalispell SDH&ES, KWQB #8	30N21W34BCD	6/12/73	Flow	429	HCO_3	100	F.Coliform	16
			Temp.	14.0	CO_3	0	Cd	---
			Turbidity	3.6	SO_4	1.5	Zn	---
			S.Conductance	153	Cl	0.5	As	---
			pH.	8.29	F.	---	Fe	---
			Ca	23	NO_3.	0.20	Cu	---
			Mg	5.5	PO_4.	0.13	Pb	---
			Na	1.2	BOD_5	2.4	DO	9.2
			K.	---	T.Coliform	63	TSS	16.0

(1) Concentrations are in milligrams per liter unless otherwise indicated

(2) TR-Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

TABLE 10

UPPER FLATHEAD DRAINAGE BASIN WATER QUALITY SUMMARY (Cont.)

SAMPLING STATION DESIGNATION	SAMPLING LOCATION	DATE SAMPLED						
Whitefish River near Kalispell SDH&ES KWQB #8	30N21W34BCD	9/25/73	Flow	59	HCO_3	118	F.Coliform	14
			Temp.	12.2	CO_3	0	Cd	<0.01
			Turbidity	4.1	SO_4	5.1	Zn	<0.01
			S.Conductance	180	Cl	0.2	As	<0.01
			pH	8.26	F	---	Fe	<0.01
			Ca	26	NO_3	0.05	Cu	<0.01
			Mg	6.1	PO_4	0.28	Pb	<0.01
			Na	1.8	BOD_5	0.8	DO	8.9
			K	---	T.Coliform	200	TSS	4.4
Stillwater River near Whitefish SDH&ES KWQB #5	30N22W34CBA	6/14/73	Flow	487	HCO_3	124	F.Coliform	78
			Temp.	15.0	CO_3	0	Cd	---
			Turbidity	6.7	SO_4	1.0	Zn	---
			S.Conductance	185	Cl	0.3	As	---
			pH	8.33	F	---	Fe	---
			Ca	27	NO_3	0.16	Cu	---
			Mg	6.7	PO_4	0.05	Pb	---
			Na	1.4	BOD_5	1.3	DO	8.3
			K	---	T.Coliform	155	TSS	48
Same as above station	"	9/25/73	Flow	84	HCO_3	150	F.Coliform	21
			Temp.	11.5	CO_3	0	Cd	<0.01
			Turbidity	4.2	SO_4	8.5	Zn	<0.01
			S.Conductance	250	Cl	0.4	As	<0.01
			pH.	8.22	F.	---	Fe	<0.01
			Ca	36	NO_3.	0.11	Cu	<0.01
			Mg	8.9	PO_4.	0.03	Pb	<0.01
			Na	2.0	BOD_5	0.8	DO	9.4
			K.	---	T.Coliform	150	TSS	5.2

(1) Concentrations are in milligrams per liter unless otherwise indicated

(2) TR-Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

Lake Blaine-the heavily developed shoreline of Lake Blaine is probably the cause of the moderate eutrophication there. Heavy recreational use plus 40 permanent residences, a camp and a resort contribute to the problems.

Rogers Lake-this lake is naturally eutrophic and as trout populations could not survive well, it was planted with grayling which are now numerous. The watershed is mismanaged as evidenced by livestock trampling the shoreline and spending considerable time in the lake on state lands. Subdivision is increasing on the private sector of the lake, and summer homes have been built on leased state lands. Some 35 shoreline cabin site leases have been granted on state lands.

Lake Five-this lake is becoming somewhat eutrophic, due primarily to heavy summer home development along the shoreline. Septic tanks and a deposit of 30-year old wood wastes on the lake bottom warrant continued monitoring.

Nearly all accessible lakes in the basin experience some problems, but those listed above are the most seriously affected of the larger and more heavily used lakes.

Phosphate Budget-Flathead Drainage Basin

(a) Background Information

Phosphate contributions to the Flathead drainage are of great importance to downstream Flathead Lake because of the algal growths which are encouraged by these nutrients. Tibbs, et al, (Ref. 9) established that phosphate is the limiting factor controlling algal growth.

Water quality and streamflow data from several separate sources is available for a number of stations in the Flathead drainage, making it possible to calculate phosphate loadings for the major tributaries of Flathead Lake. The data has been so utilized, with the results shown on Figure 4. All data utilized was total phosphate concentration data, obtained from unfiltered samples, hence including dissolved and particulate fractions. All information is expressed as PO_4, rather than as P. (Expressing a measured amount of phosphorus as PO_4 results in 3.13 times larger numbers than does expressing the same amount as P).

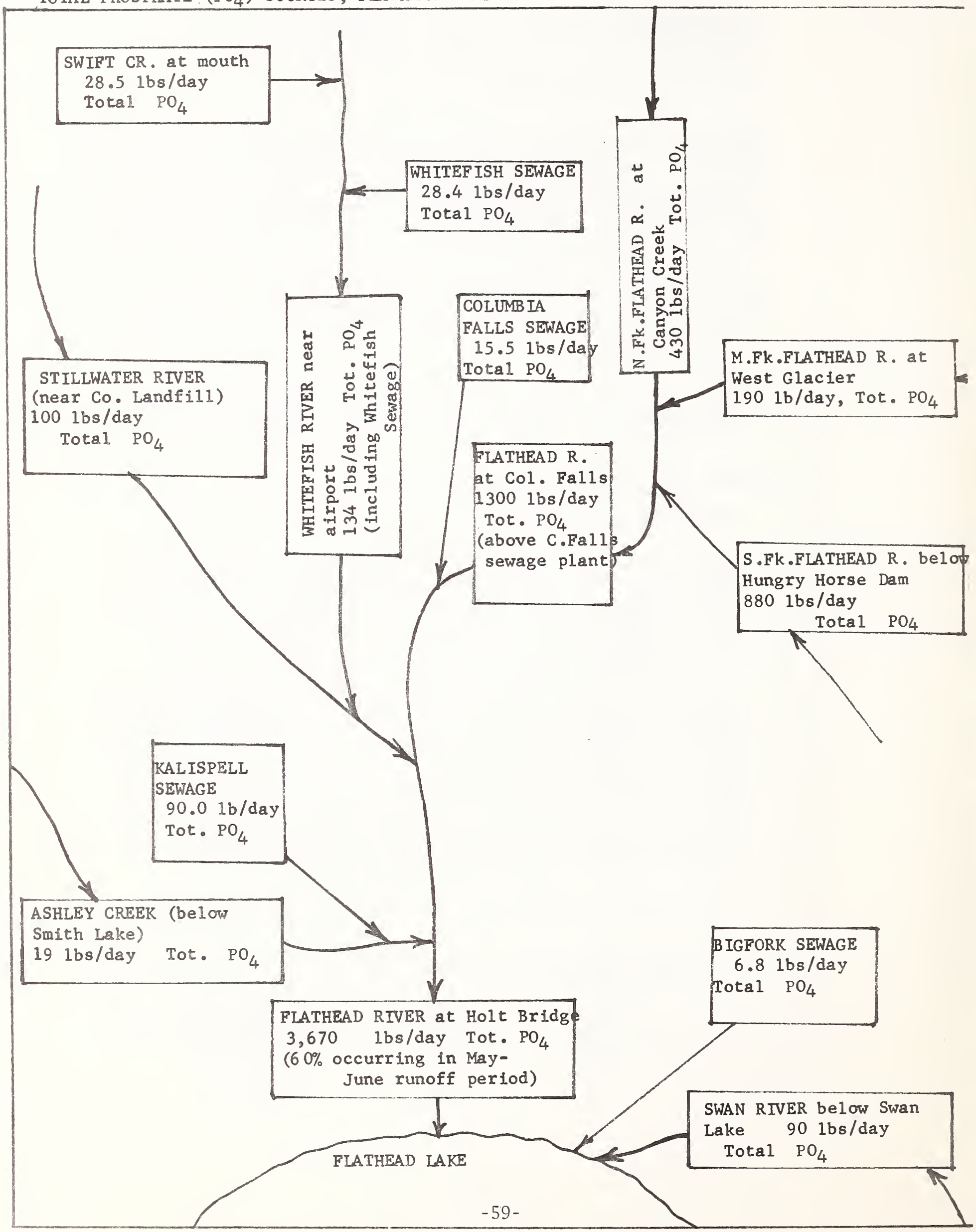
The phosphate concentration data were interpreted as follows:

(1) All total phosphate concentrations from a previous chemical sampling program were recorded.

(2) U.S. Geological Survey flow data corresponding to the same days the samples were collected were obtained from USGS published records. (Ref. 1)

FIGURE 4

TOTAL PHOSPHATE (PO_4) SOURCES, FLATHEAD DRAINAGE



(3) The flow and concentration data were converted to pounds of phosphate for that particular day, as in the following example:

T-PO_4 concentration = 0.10 mg/1

Flow rate = 1000 cfs

$$\text{Pounds of } PO_4 = \left(0.10 \frac{mg}{1}\right)\left(1000 \frac{ft^3}{Sec}\right)\left(3600 \frac{Sec}{hr}\right)\left(24 \frac{hr.}{day}\right)\left(62.4 \frac{lb.}{ft^3}\right)$$

$$= 539 \text{ lbs. } PO_4$$

(noting that mg/1 is equivalent to lbs./million lbs.)

(4) Daily data representing each month were added together, and divided by 12, to obtain an average daily loading of PO_4, in pounds, for each station.

(5) In the special case of sewage plant sources, the phosphate concentrations and flow rates were obtained from self-monitoring data, measured over the duration of one year (see Water Pollution Sources section-discharge characteristics tables, and "Municipal Tertiary Treatment" discussion).

(6) Water quality data for all stream stations except Flathead River at Holt Bridge were taken from state Dept. of Health and Environmental Sciences studies during 1972-1973. The Holt Bridge station data was obtained from two sources, including U.S. Geological Survey data and State Health Dept. data. Daily loadings at Holt Bridge were obtained by averaging the two results.

It is noted here that the U.S. G.S. phosphorus data at Holt Bridge, as published for the period July 1967 to June 1971 (Ref. 2) apparently is in error. The total phosphorus values are therein reported as P. Comparisons with other data measured at the same station during similar months of different years show the USGS data to be always 2 to 10 times higher. While this is a rough comparison, probability suggests that the two sources should compare much better than this. If the USGS data were erroneously reported as P, and was actually PO_4 data, the comparison would be well within the limits of probability. Also, the USGS data, if correctly reported as P, appears to be unreasonably high for the Flathead River system. For the purposes of this nutrient budget, it is assumed that the USGS data referenced above should have been properly recorded as PO_4, rather than as P. Calculations for phosphate loadings at Holt Bridge were based on this assumption. The USGS daily PO_4 loadings at Holt Bridge were averaged with similar loadings calculated using State Health Dept. data, to obtain the average daily loading of 3672 lbs./day total PO_4 entering Flathead Lake via Flathead River. This estimated loading is about 15% lower than reported by Tibbs (Ref. 9).

Information on the phosphate data sources is shown below:

STATION	SAMPLING AGENCY	DATES OF STUDY	NUMBER OF SAMPLES
S.F. Flathead R. nr. Col. Falls	State Health	Oct.'72-Oct.'73	14
N.F. Flathead R. nr. Col.Falls	" "	" "	14
M.F. Flathead R. nr. W.Glacier	" "	" "	14
Flathead R. at Col. Falls	" "	" "	11
Stillwater R. nr. Whitefish	" "	Oct.'72-June'74	16
Whitefish R. nr Kalispell	" "	Oct.'72-Oct.'73	13
Ashley Cr. nr. Kalispell	" "	Jan.'73-Oct.'73	12
Swift Cr. nr. Whitefish	" "	Oct.'72-Oct.'73	15
Swan R. nr. Bigfork	" "	" "	13
Flathead R. nr. Bigfork	U.S.G.S.	July'69-June'71	23
Flathead R. nr. Bigfork (same as above)	State Health	Oct.'72-June'74	13

(b) Accuracy of Results

The results of the phosphate budget, as shown on Figure 4 are felt to be generally quite reliable. The heavy loading of 880 lbs./day shown for the South Fork Flathead River is probably too high, as a single very high sample strongly influenced the results. A more reasonable loading at this station is probably in the order of 500 lbs./day; still considerably higher than one would expect below the large reservoir.

Several streams had phosphate concentrations below detectable limits (less tha 0.03 mg/l as PO_4) on several occasions. In such instances, values less than 0.03 mg/l were assumed, such as 0.02 or 0.01 mg/l. The results are still probably fairly reliable for these stations, as the monthly averages are much more strongly influenced by the higher readings than by these assumed low readings. Stations at which more than one third of the readings fall into the "below detectable limits" category are as follows:

N.F. Flathead at Canyon Creek
M.F. Flathead at West Glacier
Flathead R. at Columbia Falls
Swift Creek at mouth
Flathead R. at Holt Bridge (Health Dept. data only)
Swan R. below Swan Lake

The phosphate loadings from the sewage plants in the area are felt to be very reliable. Variations in phosphate concentrations and flow rates are not nearly as great in sewage systems as in natural streams, thus average values are more reliable. The sewage plant contributions are quite regular regardless of season, while contributions from streams are strongly influenced by high spring runoff values. At Holt Bridge, approximately 60% of the annual phosphate loads arrive during the months of May and June.

(c) Phosphorus Compounds-a discussion

Before discussing the results of the phosphate budget, it is well to define exactly which parameter is being used. Phosphorus exists in soluble forms and in particulate form, the latter usually closely associated with suspended sediment. The soluble forms may be expressed as ortho phosphate, or as total dissolved phosphate. Total dissolved phosphate plus particulate phosphorus may be measured as total phosphorus. Ortho phosphate, total dissolved phosphate, or total phosphorus may be expressed either as P or as PO_4; thus phosphorus compounds may be measured and expressed in any one of six ways. This has resulted in great confusion, as some phosphate analyses of record are improperly expressed, or are not defined at all.

For the purposes of this budget, total phosphorus, expressed as PO_4, was used. Such measurements are obtained by digesting all phosphorus compounds in an unfiltered water sample to phosphate form (persulfate digestion), and then measuring the total phosphates, such as by the ascorbic acid technique. Total phosphorus as PO_4, used herein, includes all dissolved, particulate and chemically bound forms of phosphate.

During springtime runoff periods, streams carry some particulate clay, which contains some chemically bound phosphorus. This is why springtime loads constitute a major fraction of the annual phosphate contribution to the Flathead drainage. Perhaps more germain to the problem of Flathead Lake algal growth would be a phosphate budget using total dissolved phosphate data. Such data was not available for most stations in the basin, however, so total phosphorus as PO_4 was used.

(d) Interpretation of Results

Referring to Figure 4 showing the results of the total phosphorus (PO_4) budget, several rather striking features may be noted. Most obvious is the great increase in phosphorus between Columbia Falls and Flathead Lake, most of which cannot be accounted for through tributaries or sewage plants. At Columbia Falls, some 1300 lbs./day total phosphorus (PO_4) passes daily through the Flathead River. Between there and Flathead Lake, another 360 lbs./day can be attributed to the Whitefish and Stillwater Rivers, Ashley Creek and the sewage plants. But at Holt Bridge (Flathead River mouth), 3670 lbs./day is present, leaving some 2000 lbs./day, or 55% of the total loading, unaccounted for.

The loading shown for Holt Bridge is considered conservative, if anything. Thus, the main lower Flathead valley is contributing the bulk of the nutrient loadings to Flathead Lake. The area contributing these loadings is defined as follows: the entire Flathead drainage between Columbia Falls and Flathead Lake, exclusive of the Whitefish drainage above Glacier International Airport, the Stillwater drainage above the Flathead County landfill and the Ashley Creek drainage above Smith Lake. In this valley area is located the majority of the population and most of the agricultural activity in the drainage. There is little logging activity in this defined area. Also, based on the known phosphate loadings from the municipal sewage plants, it is doubtful whether the unsewered population (ie, Evergreen area) is contributing greatly to this heavy phosphorus loading from the lower valley. Of much greater suspect are the agricultural activities in the area, particularly runoff and seepage from livestock wastes and crop fertilization.

Other observations may be made of the upper valley stations. The three forks of the Flathead River in particular, seem to have a story to tell. The only significant activities in the three forks is logging. Several towns are located in the Middle Fork Flathead drainage, but all are well away from the river and none have sewage discharges. Some logging has taken place in the upper Middle Fork (Bear Creek drainage), but relatively little of the drainage has been logged. The North Fork Flathead River has been extensively logged along its west side tributaries. The South Fork has been extensively logged, but all runoff waters pass through the large Hungry Horse Reservoir.

As mentioned earlier, the loading shown for the South Fork Flathead is probably too high. Nevertheless, the drainage is richer in phosphates than either of the other two forks, apparently showing the effects of logging. Also, the heavily logged North Fork discharges more than twice the phosphates as the relatively unlogged Middle Fork. Based strictly on the relative sizes of the three forks, it is estimated that some 500 lbs./day of total phosphorus (as PO_4) is resulting from logging activities in the three forks of the Flathead River. This amounts to approximately 40% of the total phosphorus carried by the main river at Columbia Falls, but only about 14% of the total entering Flathead Lake via the Flathead River.

Elsewhere in the drainage basin, it may be noted that the Swan River is quite low in nutrients, contributing only 90 lbs./day total phosphorus (PO_4) to Flathead Lake. The Swan River contributes 11% of the flow to Flathead Lake, but only about 2% of the phosphorus. On the other hand, the Whitefish and Stillwater Rivers contribute slightly more than their proportionate share of phosphorus, and these loadings were determined some 15 miles above the river mouths.

(e) Sewage Plants and the Phosphorus Budget

Ashley Creek was monitored about one mile below Smith Lake. At that point the stream carried about 19 lbs./day total phosphorus (PO_4). Below the sewage plant, the stream flow rate is not significantly altered, but the phosphorus loading is increased nearly six-fold. It is primarily this nutrient loading that causes the severe summer growths of algae and duckweed in lower Ashley Creek as well as an occasional green plume in the Flathead River when rafts of the floating duckweed drift downstream. Such green plumes have occasionally been reported as far downstream as Holt Bridge (Somers-Bigfork cutoff). Alternatives for improving this situation include nutrient removal at the Kalispell sewage plant and extending the sewage outfall pipe to the Flathead River. Phosphate removal from sewage systems is very expensive, both to construct and to operate, and is only about 70% efficient. The phosphate concentrations in lower Ashley Creek after nutrient removal at Kalispell would still be twice as high as upstream Ashley Creek and would probably be more than sufficient to continue the algal growth problems. Extending the sewage outfall to the Flathead River would very probably solve the lower Ashley Creek algal problems. In addition, little or no adverse effects would be noticeable in the Flathead River, as the wastewaters are flowing into it via Ashley Creek at the present time. Dilution in the Flathead River would reduce nutrient concentrations to levels too low to support nuisance algal problems there. An outfall to the Flathead River would be approximately two miles long, and would be expensive to construct.

A third alternative to reducing nutrients in lower Ashley Creek would be spray irrigation of the sewage effluent. Sufficient land for this purpose does not appear to be available (Ref. 37).

As discussed in Section VI, "Water Pollution Sources," phosphorus loadings from the four sewage treatment plants constitute only about 3.7% of the total loading to Flathead Lake. Nutrient removal at all four plants would be about 70% efficient, reducing the total phosphorus loading to Flathead Lake by approximately 2.6%. This is a somewhat simplified view of the situation, however. Most of the phosphorus in the sewage effluents is dissolved phosphate, and is more available for algal production than the great loadings of phosphorus entering Flathead Lake in the springtime, bound up in suspended sediment in the Flathead River. Also, Tibbs (Ref. 9) showed that much of the seasonal surge of stream borne phosphorus is settled to the bottom of Flathead Lake, to remain there more or less permanently. Sewage nutrient loadings are fairly constant during all seasons, and would provide phosphates for algal growth even during the critical late summer months when stream-borne phosphorus loadings are lower than average.

Nevertheless, the nutrient loadings from sewage plants in the Flathead drainage are felt to be rather insignificant when compared with other nutrient sources. A more positive statement to this effect will have to await a more refined nutrient budget for the drainage, utilizing dissolved phosphate data measured by methods having lower detection limits than were employed for these data. Such a refinement of the nutrient budget is suggested in Section XIII as a future planning need.

TABLE 11 UPPER FLATHEAD WATER QUALITY STATIONS

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY STANDARDS
Swan River (Bigfork bridge) (2) (EPA Storet #3003G1)	27N20W36	Oct. 1974-Oct. 1975	Monthly	NITRATES PHOSPHATES FLOW RATE
Bohannon Creek (Flathead Lake) (2) (EPA Storet #3003H1)	25N19W29/30	"	"	
Teepee Creek (Flathead Lake) (2) (EPA Storet #3003J1)	24N19W22	"	"	"
Hellroaring Creek (Flathead Lake) (2) (EPA Storet #3003K1)	23N19W32	"	"	"
Whitefish River (outlet, Whitefish Lake) (2) (EPA Storet #3016A1)	31N22W36	"	"	"
Beaver Creek (Whitefish Lake) (2) (EPA Storet #3016B1)	31N22W22	"	"	"
Lazy Creek (Whitefish Lake) (2) (EPA Storet #3016C1)	31N22W05	"	"	"
Swift Creek (Whitefish Lake) (2) (EPA Storet #3016D1)	31N22W05	Oct. 1974-Oct. 1975	Monthly	
Hellroaring Creek (Whitefish Lake) (2) (EPA Storet #3016E1)	31N22W03	"	"	"
Ronan Creek (Lk. Mary Ronan) (2) (EPA Storet #3007A1)	25N22W24	"	"	"
Freeland Creek (Lk. Mary Ronan) (2) (EPA Storet #3007B1)	25N22W15	"	"	"
Donaldson Creek (Lk. Mary Ronan) (2) (EPA Storet #3007C1)	25N22W11	"	"	"
Logan Creek (2) (Tally Lake Outlet) (EPA Storet #3012A1)	31N23W29	"	"	"
Logan Creek (2) (Tally Lk. Inlet) (EPA Storet #3012A2)	31N23W30	"	"	"
Flathead River, Kerr Dam (2) (EPA Storet #3003A1)	22N21W12	Oct. 1974-Oct. 1975	Monthly	NITRATES PHOSPHATES FLOW RATE
Polson Sewage pond outlet (2) (EPA Storet #3003B1	22N20W08	"	"	"
Dayton Creek (Flathead Lake) (2) (EPA Storet #3003C1)	24N 21W03	"	"	"
Proctor Creek (Flathead Lake) (2) (EPA Storet #3003D1)	24N21W03	"	"	"
Forrey Creek (Flathead Lake) (2) (EPA Storet #3003E1)	25N20W09	"	"	"
Stoner Creek (Flathead Lake) (2) (EPA Storet #3003F1)	26N20W18	"	"	"
Flathead River (Somers Cutoff) (2) (EPA Storet #3003A2)	27N20W23	"	"	"
Unnamed Creek (Tally Lk) (2) (EPA Storet #3012B1)	30N23W05	Oct. 1974-Oct. 1975	Monthly	
Swan River (Swan Lk. Outlet) (2) (EPA Storet #3011A1)	26N19W11	"	"	"
Johnson Creek (Swan Lake) (2) (EPA Storet #3011B1)	27N19W14	"	"	"
Sixmile Creek (Swan Lake) (2) (EPA Storet #3011C1)	26N18W30	"	"	"
Swan River (Swan Lake Inlet) (2) (EPA Storet #3011A2)	25N18W16	"	"	"
Bond Creek (Swan Lake) (2) (EPA Storet #3011D1)	25N18W24	"	"	"
Groom Creek (Swan Lake) (2) (EPA Storet #3011E1)	25N18W14	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Hall Creek (Swan Lake) (2) (EPA Storet #3011F1)	25N18W11	Oct. 1974-Oct. 1975	Monthly	Nitrates, phosphates, flow rate
McDonald Creek (Lk.McDonald Outlet) (2) (EPA Storet #3008A1)	32N19W23B Center	"	"	"
Fish Creek (Lk. McDonald) (2) (EPA Storet #3008B1)	32N19W11DB	"	"	"
Snyder Creek (Lk. McDonald) (2) (EPA Storet #3008C1)	33N18W14CC	"	"	"
Jackson Creek (Lk. McDonald) (2) (EPA Storet #3008D1)	33N18W14	"	"	"
Sprague Creek (Lk. McDonald) (2) (EPA Storet #3008E1)	33N18W23CC	"	"	"
McDonald Creek (Lk.McDonald Inlet) (2) (EPA Storet #3008A2)	33N18W11DA	"	"	"
Lower Logan Creek (3) (Logan Cr. Study #1) (State Health Dept.)	30N24W04AAA	Aug. 1974 to Present	*Varies; emphasis on spring runoff. Approx 24 samples/year*	*First Year: Discharge, Temp. (continuous), TSS, Turbidity, Fecal Coliform, Conductivity, Ortho Phosphate, NO_3 + NO_2, pH, Organic Color, D.O. all each time. Complete chemical + Heavy Metals once. Alkalinity 4 times/year. Second Year: Drop: D.O., Fecal Coliform, Annual Complete Chem., Annual Metals. Add: Alkalinity, Ca, Mg, Na, K, SO_4, Cl, Composite TSS, Bed Load, each time.*
Middle Logan Creek (3) (Logan Cr. Study #2) (State Health Dept.)	30N24W28ADD	Aug. 1974 to Present	"	"
Upper Logan Creek (3) (Logan Cr. Study #3) (State Health Dept.)	29N24W10CCB	Aug. 1974 to Present	"	"
Lower Griffin Creek (3) (Logan Cr. Study #4) (State Health Dept.)	30N25W35ACA	Aug. 1974 to Aug. 1975	"	"
Lower Hand Creek (3) (Logan Cr. Study #5) (State Health Dept.)	29N25W03ADA	Aug. 1974 to Present	"	"
Upper Hand Creek (3) (Logan Cr. Study #6) (State Health Dept.)	29N25W03ADB	Aug. 1974 to Present	"	"
Dunsire Creek (3) (Logan Cr. Study #7) (State Health Dept.)	30N25W05CCD	Aug. 1974 to Aug. 1975	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	(1) LOCATION	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Stoner Creek (USFS) (6)	26N21W15DCC	June-July 1973	4 samples	*Ca, Mg, Na, K, Fe, Mn, SiO_2, HCO_3, CO_3, OH, Cl, SO_4, NO_3, F, pH, Temp. Cond., SAR Hardness, Alkalinity, Total PO_4*
Stoner Creek at AirForce Base (6) (USFS)	26N20W13CDB	June-July 1973	4 samples	"
Stoner Creek at mouth (6) (USFS)	26N20W18DBA	June-July 1973	4 samples	"
Stoner Creek at Lakeside (5) SDH&ES KWQB #26	26N21W18BAD	July & Sept. 1973 Apr. 1974	3 samples	*HCO_3, CO_3, OH, NO_3, pH, Temp., Calc. Diss. Solids, Cond., SAR, Hardness, Alkalinity, Air Temp., TSS, BOD_5, Total Coliform, Ortho PO_4, Turbidity, D.O., Fecal Coliform, Total PO_4, Ca, Mg, Na, Cl, SO_4, Fe, Pb, Cu, Hg, As, Zn, Cd*
M.F. Flathead River @ Schaefer Meadow (7) (USFS-State Health)	27N13W26CAB	Nov. 1973 to Present	*Occasional samples, will cont. sporadically*	*Ca, Mg, Na, HCO_3, CO_3, OH, Cl, SO_4, NO_3, PO_4, pH, Temp., Cond., SAR, Hardness, Alkalinity, Turbidity, Fe, Pb, Cu, Hg, As, Cd, Zn, NH_4-N, TSS, BOD, Fecal Coliform, D.O., C.O.D., Ortho PO_4, (Parameters not consistently same each time)*
S.F. Flathead River @ Meadow Creek (7) (USFS-State Health)	24N14W08AAC	"	"	"
Hilburn Creek (8) (Lake Mary Ronan area) (Weber & Assoc)	25N22W16DDA	Feb.-Nov. 1976 (proposed)	*13 per year emphasis on spring run-off*	*pH, HCO_3, Cond., TSS, SO_4, Na, K, Ca, Mg, Discharge, log (CSM), log (EC), Temp., Bedload, Suspended Sediment*
E.Fk. Swift Creek (9) (Whitefish Drainage) (MT. DNR&C #10)	33N23W03ACB	May 1974 to Present	*Irregular 7-10/year emphasize spring run-off*	*Temp., Cond., pH, Stage, Discharge, TSS, Total Alkalinity, Total Hardness, Non Carb. Hardness*
W.Fk. Swift Creek (9) (Whitefish Drainage) (MT DNR&C #11)	34N23W34CCB	"	"	"
Antice Creek (9) (Whitefish Drainage) (MT DNR&C #9)	33N23W15DDB	"	"	"
Hellroaring Creek (9) (Stillwater Drainage) (MT DNR&C #15)	34N24W20BDA	"	"	"
Fitzsimmons Creek (9) (Stillwater Drainage) (MT. DNR&C) #13)	34N24W05ACC	"	"	"
Chepat Creek (9) (Stillwater Drainage) (MT DNR&C #14)	34N24W05BDB	"	"	"
Unnamed Creek (9) (trib-Whitetail Cr. Swan Drainage) (MT. DNR&C #10)	24N18W25BCB	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Upper Cyclone Cr. (3) (Logan Cr. Study #8) (State Health Dept.)	29N24W14ACD	Sept. 1975 to Present	*Varies; emphasis on spring run-off. Approx. 24 samples/ year*	*Discharge, Temp. (continuous), TSS with Torpedoe composite sampler, Turbidity, Conductivity, Ortho PO_4, NO_3 + NO_2, pH, Organic Color, Alkalinity, Ca, Mg, Na, K, SO_4, Cl, Bed Load*
Lower Cyclone Cr. (3) (Logan Cr. Study #9) (State Health Dept.)	29N24W10BDD	Sept. 1975 to Present	"	"
N.F. Flathead near Columbia Falls (4) (State Health, KWQB-13)	32N20W35BCA	Oct. 1972 to Nov. 1973	Monthly	*D.O., pH, water and air temp., Conductivity, Total Coliforms, BOD_5, Turbidity, NO_3 + NO_2, Ortho PO_4, Total PO_4, Ca, Mg, Na, SO_4, Cl, HCO_3, CO_3*
M.F. Flathead near West Glacier (4) (St. Health, KWQB-14)	32N19W34ACC	"	"	"
S.F. Flathead R. (4) below H.Horse Dam (St.Health, KWQB-15)	30N19W16CDC	"	"	"
Stillwater River near Olney (5) (St.Health, KWQB-6)	31N23W10AD	Oct. 1972 to Dec. 1973	*4samples @ 10/72, 11/72 7/73, 11/73*	"
Stillwater River (4) near Whitefish (St.Health, KWQB-5)	30N22W34C N¾ corner	Oct. 1972 to Nov. 1973	Monthly	"
Swift Creek near Whitefish (4) (St.Health, KWQB-19)	31N22W05BBA	Oct. 1972 to Nov. 1973	Monthly	"
Whitefish River near Kalispell (4) (St.Health, KWQB-8)	30N21W34BCD	"	"	"
Ashley Creek near (4) Kalispell (below STP) (St.Health, KWQB-11)	28N21W29BAC	"	*Six samples approx. Bi-Monthly*	"
Upper Swan River near Condon (4) (St.Health KWQB-21)	19N16W08BBD	"	Monthly	"
Swan River above Swan Lake (4) (St.Health, KWQB-18)	25N18W34ADD	"	"	"
Swan River near Bigfork (4) (St.Health, KWQB-17)	26N19W11BAD	"	"	"
S.F. Flathead R. (5) above H.H.Reservoir (St.Health, KWQB-23)	24N14W08AAC	Aug., Nov. 1973	2 Samples	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Stillwater R. at Olney (4) (St.Health,KWQB -25)	32N23W18DAD	Jan.-Oct. 1973	Monthly	*D.O., pH, Water & air Temp., Conductivity, Total Coliform, BOD_5, Turbidity, $NO_3 + NO_2$, Ortho PO_4, Total PO_4, Ca, Mg, Na, SO_4, Cl, HCO_3, CO_3*
Ashley Creek near Kalispell (6.3 mi.W.) (St.Health,KWQB-24)	28N22W32BAC	Jan.-Oct. 1973	Monthly	"
Spring Creek at Kalispell (5) (St.Health,KWQB-01)	28N21W03BCC	Oct. 1972 to Nov. 1973	*4 samples 10/72, 5/73, 7/73, 11/73*	"
Trumbull Creek near Kalispell (5) (St.Health,KWQB-02)	29N21W28ABA	Oct. 1972 to Nov. 1973	*3 samples 10/72, 7/73, 11/73*	"
Spring Creek near Kalispell (5) (St.Health,KWQB-03)	29N21W27ABA	Dec. 1972 to Nov. 1973	*4 samples 12/72, 5/73, 7/73, 11/73*	"
Stillwater River at Kalispell (5) (St.Health,KWQB-04)	28N21W09CAB	Dec. 1972 to Nov. 1973	*3 samples 12/72, 7/73, 11/73*	"
Whitefish River at Kalispell (5) (St.Health,KWQB-07)	28N21W04CCB	Dec. 1972 to Dec. 1973	*5 samples 12/72, 7/73, 8/73, 11/73, 12/73*	"
Whitefish River at Whitefish (5) (St.Health,KWQB-09)	31N22W36BAC	Dec. 1972 to Nov. 1973	*3 samples 12/72, 7/73 11/73*	*D.O., pH, Water & Air Temp., Conductivity, Total Coliforms, BOD_5, Turbidity, $NO_3 + NO_2$, Ortho PO_4, Total PO_4, Ca, Mg, Na, SO_4, Cl, HCO_3, CO_3*
Ashley Creek @ Kalispell (above STP) (5) St.Health,KWQB-10)	28N21W20BCC	Dec. 1972 to Nov. 1973	*5 samples 12/72, 3/73, 5/73, 7/73, 11/73*	"
Ashley Creek at Flat-River (5) (St.Health,KWQB-12)	27N21W02BCB	Dec. 1972 to Aug. 1973	*5 samples 1972-Dec. 1973-Apr., May,July,Aug.*	"
Flathead R. at Columbia Falls (5) (St.Health,KWQB-16)	30N20W17DBB	Oct.-Dec. 1972 / Mar.-Oct. 1973	Monthly	"
Lazy Creek near Whitefish (5) (St.Health,KWQB-20)	31N22W05CCB	Oct. 1972 to Nov. 1973	*6 samples 10/72, 4/73, 5/73, 7/73 10/73, 11/73*	"
Flathead River near Bigfork (5) (St.Health,KWQB-22)	27N20W23BBC	Oct. 1972 to Oct. 1973	Monthly + Occasional samples to present time	"
Stoner Creek at supply USFS (6)	26N21W30AAA	June-July 1973	4 samples	*Ca, Mg, Na, K, Fe, Mn, SiO_2, HCO_3, CO_3, OH, Cl, SO_4, NO_3, F, pH, Temp., Cond. SAR, Hardness, Alkalinity, Total PO_4*

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Stoner Creek (Lakeside Area) (8) (Weber & Assoc.)	26N21W15CCD	Feb.-Nov. 1976 (proposed)	*13 per year emphasis on spring run-off*	*pH, HCO_3, Cond., TSS, SO_4, Na, K, Ca, Mg, Discharge, log (CSM), log (EC), Temp., Bedload, Suspended Sediment*
Beta Creek (8) (near Hungry Horse Dam) (Weber & Assoc.)	30N19W27DBA & 30N19W34BCB	"	"	"
"Creek 34-208" (8) (Near H.Horse Dam) (Weber & Assoc.)	30N19W26CCC & 30N19W34ABC	"	"	"
Natrona Creek (8) (Hungry Horse Reser.) (Weber & Assoc.)	29N18W36DCD	"	"	"
S.F. Lost Creek (9) (Swan Drainage) (MT. DNR&C #9)	24N17W05CBB	May 1974 to Present	Irregular *7-10/year emphasize spring run-off*	*Temp., Cond., pH, Stage, Discharge, T.S.S., Tot. Alkalinity, Tot & Non Carb. Hardness*
Soup Creek (9) (Swan Drainage) (MT. DNR&C #7)	24N17W27CBA	"	"	"
Cilly Creek (9) (Swan Drainage) (MT. DNR&C #8)	24N17W07BDD	"	"	"
Goat Creek (9) (Swan Drainage) (MT. DNR&C #6)	23N17W16BDB	May 1974 to Present	*Irregular 7-10/year emphasize spring run-off*	"
Squeezer Creek (9) (Swan Drainage) (MT. DNR&C #5)	23N17W21BBB	"	"	"
Woodward Creek (9) (Swan Drainage) (MT. DNR&C #12)	23N18W25BDD	"	"	"
Woodward Creek (9) (Swan Drainage) (MT. DNR&C #11)	23N18W12DCC	"	"	"
Whitetail Creek (9) (Swan Drainage) (MT. DNR&C #13)	24N18W35BCC	"	"	"
Brush Creek (9) (Whitefish Drainage) (DNR&C #8)	31N22W05ABB	"	"	"
Chicken Creek (9) (Whitefish Drainage) (MT. DNR&C #12)	33N23W14DCC	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	(1) LOCATION	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
S.F. Flathead River above Twin Cr. near H. Horse Mt (10) (USGS #12359800)	26N16W36ABA	1965-Present	Daily	*Maximum and minimum water temperature*
Flathead River near Bigfork, MT (10) (USGS 12369000)	27N20W22AA	Oct. 1970-June 1971	Monthly	*Each time: Discharge, Ca, K, SO_4, Cl, F, TDS, Hardness, Turbidity, NO_3, NO_2, NH_4, Org-N., PO_4, Ortho PO_4, Tot.P, TOC, BOD, Temp., S.C., D.O., pH, Alkalinity, Total & Fecal Coliform. Every Third Time: Al, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Mn, Hg, Sr, Zn, Pb, Mg, Mo, Ni, Se, Ag, V.*
Same as above	Same as above	Oct. 1969 to Sept. 1970	Monthly	*Each Time: Q, Fe, Na, K, SO_4, Cl, F, NO_3-N, B, TDS, Hardness, NO_2-N, NH_3-N, Org. N, Ortho PO_4, Tot. PO_4, TOC, BOD_5, Turb., Color, Temp., S.C., D.O., pH, Alkalinity, Total & Fecal Coliform. First 10 months only: Al, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sr, V, Zn.*
Same as above	Same	July-Sept. 1969	Monthly	*Q, Fe, K, Cl, NO_3, F, B, TDS, Hardness, Color, NH_4, NO_2, Org. N., Tot. P., Diss.P, Turb., BOD_5, TOC, Al, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Ag, Sr, V, Zn, Alk., D.O., pH, S.C., Temp., Total & Fecal Coliform*
Flathead Lake at Polson, MT (10) (USGS #12371550)	22N20W04ACC	Same as above 3 entries	Same as above 3 entries	Parameters and frequencies same as above 3 entries
Flathead River near Kalispell (10) (USGS #12363500)	28N21W10BAA	See notes at right	Daily	Water Temperature: 1949-1950, 1963-1969 Suspended Sediment: 1965-1969
Ashley Creek near Kalispell (10) (USGS #12367500)	28N22W29BAA	7/8/69	Single sample	*Q, Cl, NO_3, TDS, Hardness, Color, NH_3-N., NO_2-N., Org. N., Total P.*
Ashley Creek below Kalispell (10) (USGS #12367800)	28N21W33BCC	7/8/69	Single sample published	*Q, Cl, NO_3, TDS, Hardness, Color, NH_3-N, NO_2-N, Org. N. Total P.*
S.F. Flathead River near Columbia Falls (10) (USGS #12362500)	30N19W16CDC	1964-1968	Daily	*Water temperature*
N.F. Flathead River at Flathead, B.C. (11) (USGS-NASQAN)	In Canada, just north of U.S.A. border	Oct. 1974 to Present	*Continuous daily, monthly, quarterly as noted*	*Continuous: Discharge, Temp. Daily: Susp. Sediment, Sp. Cond., Turbidity Monthly: HCO_3, Tot & Non Carb. Hardness, Ca, Mg, F, Na, K, Residue, TDS, Diss Si, Cl, SO_4, Tot. PO_4, NO_3 + NO_2, Kjeldahl-N, Acidity, NH_3, TOC, Diss. Org. Carbon, Sus. Org. C., pH, D.O., Fecal Coliform, Fecal Strep., Phytoplankton. Quarterly: Invertebrate drift. Annually: Fishanalyses-metals. Quarterly: Periphyton, Al, As, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Se, Zn. (all metals diss. & total), benthos, bedload*
N.F. Flathead River near Columbia Falls (12) (USGS-208 Project)	32N20W35BCA	Oct. 1975 to Oct. 1976	"	same as above. Periphyton sampling moved upstream above Big Creek for better sampling site.
M.F. Flathead R. near West Glacier (12) (208 Project)	32N19W34ACC	"	Monthly	*Ca, Mg, Na, K, Fe, Mn, Al, SiO_2, HCO_3, Cl, SO_4, NO_3-N, F, pH, Temp., Sp. Cond., T. Hardness, T. Alkalinity, Zn, D.O., Turb., NO_2, Pb, O-PO_4, T-PO_4, Flow. Also quarterly benthos*
Bowman Creek (Glacier) Park) (12) (208 Project)	35N21W22AAC	"	"	"
N.F. Flathead River at Polebridge (12) (208 Project)	35N21W22DAA	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Elelehum Creek (12) (N.F. Flathead) (208 Project #11ac)	33N21W22	Oct. 1975 to Oct. 1976 (in progress)	Quarterly	*Ca, Mg, Na, K, Fe, Mn, Al, SiO_2, HCO_3, Cl, SO_4, NO_3-N, pH, Temp. Specific Conductance, Total Hardness, Total Alkalinity, Zn, C.O., Turbidity, NO_2, Pb, O-PO_4, T-PO_4, Flow Benthos*
Upper Canyon Creek (N.F. Flathead (12) (208 Project #12a)	32N21W25DDA	"	"	"
Kimmerly Creek (N.F. Flathead) (12) (208 Project #12aa)	32N20W29CBD	"	"	"
McGinnis Creek (N.F. Flathead) (12) (208 Project #12ab)	32N20W27DBB	"	"	"
Flathead R. @ Holt Bridge (nr. Flathead Lk.) (13) (MT. DF&G)	27N20W23BBC	1964-Present	Monthly & Continuous	Continuous-Temperature Monthly-Cond., Alkalinity, pH, Turbidity
S.F. Flathead River below H.Horse Dam (MT. DF&G) (13)	30N19W16CDC	"	"	"
Flathead River at Columbia Falls (13) (MT. DF&G)	30N20W17DBB	"	"	"
N.F. Lost Creek (13) (Swan Drainage) (MT. DF&G)	25N17W04	Mar.-Oct. 1972 Apr.-Oct. 1973	Approx. Twice Monthly	*pH, Total Alkalinity, Specific Conductance, Turbidity, Minimum-Maximum Flow*
Piper Creek (13) (Swan Drainage) (MT. DF&G)	22N17W18	"	"	"
Pony Creek (13) (Swan Drainage) (MT. DF&G)	22N17W34	"	"	"
Rumble Creek (13) (Swan Drainage) (MT. DF&G)	20N16W07	"	"	"
Soup Creek (13) (Swan Drainage) (MT. DF&G)	24N17W18	"	"	"
Squeezer Creek (13) (Swan Drainage) (MT. DF&G)	23N17W17	"	"	"
Woodward Creek (13) (Swan Drainage) (MT. DF&G)	23N18W25	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Upper Teepee Creek (12) (N.F. Flathead) (208 Project #3a)	36N22W09ABA	Oct. 1975 to Oct. 1976 (in progress)	Quarterly	Ca, Mg, Na, K, Fe, Mn, Al, SiO_2, Zn, HCO_3 Cl, SO_4, NO_3-N, F, pH, Temp., Cond., Tot. Hardness, Tot. Alkalinity, D.O., Turbidity, NO_2, Pb, O-PO_4, Tot. PO_4, Flow, Benthos.
Upper Whale Creek (12) (N.F. Flathead) (208 Project #4a)	36N23W29CAD	"	"	
Shorty Creek (12) (N.F. Flathead) (208 Project #4aa)	36N23W29DCB	"	"	
Akinkoka Creek (12) (N.F. Flathead) (208 Project #4ab)	36N23W26ACB	"	"	
Upper Moose Creek (12) (N.F. Flathead) (208 Project #5a)	35N22W05ABD	"	"	
Upper Red Meadow Cr. (N.F. Flathead) (12) (208 Project #7a)	35N23W23CDC	"	"	
S.F. Red Meadow Cr. (N.F. Flathead) (12) (208 Project #7aa)	35N21W07DDA	"	"	
Colts Creek (N.F. Flathead) (12) (208 Project #1)	37N22W08AAC	Oct. 1975 to Oct. 1976 (in progress)	Monthly	
Trail Creek (N.F. Flathead) (12) (208 Project #2)	37N22W35DDD	"	"	
Teepee Creek (12) (N.F. Flathead) (208 Project #3)	36N22W11CDD	"	"	
Whale Creek (12) (N.F. Flathead) (208 Project #4)	36N21W30CBD	"	"	
Moose Creek (12) (N.F. Flathead) (208 Project #5)	36N21W31ACC	"	"	
Hawk Creek (12) (N.F. Flathead) (208 Project #6)	35N21W06CCA	"	"	
Red Meadow Creek (12) (N.F. Flathead) (208 Project #7)	35N21W07DAC	"	"	

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Hay Creek (12) (N.F. Flathead) (208 Project #8)	35N21W34DBB	Oct. 1975 to Oct. 1976 (in progress)	Monthly	Ca, Mg, Na, K, Fe, Mn, Al, SiO_2, Zn, HCO_3, Cl, SO_4, NO_3-N, F, pH, Temp., Cond., Tot. Hardness, Tot. Alkalinity, D.O., Turbidity, NO_2, Pb, O-PO_4, Tot. PO_4, Flow, Benthos.
Moran Creek (12) (N.F. Flathead) (208 Project #9)	34N21W02CDC	"	"	
Coal Creek (12) (N.F. Flathead) (208 Project #10	34N20W20DCD	"	"	
Big Creek (12) (N.F. Flathead) (208 Project #11)	33N20W22CCA	"	"	
Canyon Creek (12) (N.F. Flathead) (208 Project #12)	32N20W29DBB	"	"	
Upper Trail Creek (12) (N.F. Flathead) (208 Project #2a)	37N23W33CC	"	Quarterly	
Tuchuck Creek (12) (N.F. Flathead) (208 Project #2aa)	37N23W33CB	"	"	
Upper Hay Creek (12) (N.F. Flathead) (208 Project #8a)	35N22W32BCD	Oct. 1975 to Oct. 1976 (in progress)	Quarterly	
Upper Coal Creek (N.F. Flathead) (12) (208 Project #10a)	34N22W24DBC	"	"	
S.F. Coal Creek (12) (N.F. Flathead) (208 Project #10aa)	34N22W26CCB	"	"	
Cyclone Creek (12) (N.F. Flathead) (208 Project #10ab)	34N21W35ADC	"	"	
Upper Big Creek (12) (N.F. Flathead) (208 Project #11a)	32N21W05ABD	"	"	
Kletomus Creek (12) (N.F. Flathead) (208 Project #11aa)	33N21W19CCD	"	"	
Hollowat Creek (N.F. Flathead) (12) (208 Project #11ab)	33N21W33CDC	"	"	

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Flathead R. at Blankenship Bridge (13) (MT. DF&G)	31N19W07ACD	1964-Present	Monthly	*Conductivity, Alkalinity, pH, Turbidity*
Beaver Creek (13) (Swan Drainage) (MT. DF&G)	19N16W30	Mar-Oct. 1972 Apr-Oct 1973	Approx. twice Monthly	*pH, Total Alkalinity, Specific Conductance, Turbidity, Minimum-Maximum flow*
Cedar Creek (13) (Swan Drainage) (MT. DF&G)	23N17W19	"	"	"
Condon Creek (13) (Swan Drainage) (MT. DF&G)	21N17W03	"	"	"
Cold Creek (13) (Swan Drainage) (MT. DF&G)	21N17W28	"	"	"
S.F. Cold Creek (13) (Swan Drainage) (MT. DF&G)	21N17W27	"	"	"
Dog Creek (13) (Swan Drainage) (MT. DF&G)	21N17W03	"	"	"
Elk Creek (13) (Swan Drainage) (MT. DF&G)	20N17W16	Mar.-Oct. 1972 Apr.-Oct. 1973	Approx. Twice Monthly	"
Glacier Creek (13) (Swan Drainage) (MT. DF&G)	20N17W02	"	"	"
Goat Creek (13) (Swan Drainage) (MT. DF&G)	23N17W18	"	"	"
Jim Creek (13) (Swan Drainage) (MT. DF&G)	22N17W32	"	"	"
Lion Creek (13) (Swan Drainage) (MT. DF&G)	22N17W08	"	"	"
Lost Creek (13) (Swan Drainage) (MT. DF&G)	24N17W06	"	"	"
S.F. Lost Creek (Swan Drainage(13) (MT. DF&G)	24N17W31	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	(1) LOCATION	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Flathead River Bad Rock Canyon @ Fishing Rock (14) (Biological Station)	30N20W12BBB	Jan. 1969 to July 1969	Approx. Monthly	*Cl, H_2S, NO_3, NH_3, NO_2, PO_4, Turbidity, Total Coliform, Fecal Coliform, Fecal Strept., pH*
Flathead River Hwy. 40 @ Columbia Falls (14) (Biological Station)	30N20W16BD	"	"	"
Flathead River below Soldiers Home(14) (Biological Station)	30N21W24DD	"	"	"
Whitefish River below STP outfall (14) (Biological Station)	30N21W06 South 1/3	"	"	"
Stillwater River @ Hwy. 93 Bridge (14) (Biological Station)	28N21W04CCC	"	"	"
Flathead River @ Kiwanis Lane (14) (Biological Station)	28N21W10ABB	"	"	"
Flathead River below Ashley Creek (14) (Biological Station)	28N20W30BDD	"	"	"
Ashley Creek above STP (14) (Biological Station)	28N21W19ADD	Jan. 1969 to July, 1969	Approx. Monthly	"
Ashley Creek at Hiway 93 (14) (Biological Station)	28N21W33BCC	"	"	"
Flathead River at Foys Bend (14) (Biological Station)	28N21W27ADD	"	"	"
N.F. Flathead River at Camas Creek (15) (Stanford #1)	33N20W14DAA	June 1972 to Dec. 1973	Twice Monthly	Qualitative and quantitative benthos sampling; emphasis on stonefly nymphs.
M.F. Flathead R. at West Glacier (15) (Stanford #2)	32N19W26DAA	"	"	"
Flathead R. 1 km. above S.F. (15) (Stanford #3)	30N19W06BDD	"	"	"
S.F. Flathead R. 5 km below H. Horse Dam (15) (Stanford #4)	30N19W08C	"	"	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Flathead R. east of Kalispell (15) (Stanford #5)	29N21W35ABB	June 1972 to Dec. 1973	Twice Monthly	Qualitative and quantitative benthos sampling. Emphasis on stonefly nymphs.
N.F. Flathead R. at Polebridge (15) (Stanford #A1)	35N21W22DA	"	Approx. Monthly	
M.F. Flathead R. at Walton R.S. (15) (Stanford # A2)	29N16W14CA	"	"	
Flathead River at (15) Blankenship Bridge (Stanford #A3)	31N19W07ACD	"	"	
S.F. Flathead R. at Spotted Bear R.S. (15) (Stanford #A4)	25N15W17CD	"	"	
Flathead Lake (16) Yellow Bay (Tibbs Sta. 1)	*Location in lake slightly variable. Shown on map (16)*	Sept. 1973 to Aug. 1974	*Varies; 34 samples during study.*	*Secchi disc, Total P, Kjeldahl-N, NO_3-N, PO_4-P, Fe, Co, Zn, Cu, Tot.C., SiO_2, Alkalinity, Hardness, Free CO_2, pH, D.O., Conductivity, Redox potential. Chemical, thermal, light and turbidity profiles. Phytoplankton. Two algal bio-assays.*
Flathead Lake, (16) midlake, deep (Tibbs Sta. 2)	"	"	*Varies; 33 samples during study.*	
Flathead Lake @ Yenne Point (16) (Tibbs Sta. 3)	*Location in lake slightly variable. Shown on map (16)*	Sept. 1973 to Aug. 1974	*Varies; 18 samples in study*	
Flathead Lake @ Skidoo Bay (16) (Tibbs Sta. 4)	"	"	*Varies; 20 samples in study*	
Flathead Lake (16) Polson Bay (Tibbs Sta. 5)	"	"	*Varies; 16 samples in study*	
Flathead Lake (16) Big Arm Bay (Tibbs Sta. 7)	"	"	*Varies; 14 samples in study*	
Flathead Lake (16) Bigfork Bay (Tibbs Sta. 9)	"	"	*Varies; 16 samples in study*	
Flathead Lake at Painted Rocks (16) (Tibbs Sta. 11)	"	"	*Varies; 15 samples in study*	
Flathead Lake (16) north end (Tibbs Sta 13)	"	"	*Varies; 14 samples in study*	

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVALS	WATER QUALITY PARAMETERS
Flathead River at Polson (16) (Tibbs Sta. 6)	22N20W04C	Sept. 1973 to Aug. 1974	*Varies; 20 samples in study*	*Secchi disc, Total P, Kjeldahl-N, NO_3-N, PO_4-P, Fe, Co, Zn, Cu, Tot. C., SiO_2, Alkalinity, Hardness, Free CO_2, pH, D.O., Conductivity, Redox potential. Chemical, thermal, light and turbidity profiles. Phytoplankton. Two Algal Bio-Assays.*
Flathead River at mouth (16) (Tibbs Sta. 8)	27N20W34B	"	*Varies; 14 samples in study*	"
Flathead River at Holt Bridge (16) (Tibbs Sta. 10)	27N20W23CCA	"	*Varies; 24 samples in study*	"
Swan River at Bigfork (16) (Tibbs Sta. 12)	27N20W36ACC	"	*Varies; 23 samples in study*	"
Ashley Lake Stations 1-3 (17) (Sonstelie)	28N24W14DBB 28N24W11BCD 28N23W06DCA	July 1973 to June 1974	*4 samples @ 2 depths in study*	*pH, Temperature, Conductivity, light penetration, D.O., CO_2, HCO_3, CO_3, NO_3, T-PO_4, O-PO_4, Quantitative Phytoplankton to genus*
Blanchard Lake (17) (Sonstelie)	30N22W2CDB	"	*7 samples in study*	"
Lake Blaine (17) Stations 1-2 (Sonstelie)	29N20W25CCA 29N20W35AAC	"	*10 samples, at 2 depths in study*	"
Little Bitterroot Lk. Stations 1-2 (17) (Sonstelie)	27N24W16BBD 27N24W07ADD	July 1973 to June 1974	*4 samples at 2 depths during study*	"
Echo Lake (17) Stations 1-4 (Sonstelie)	29N19W08ACD 29N19W06ACD 29N19W08AAA 29N19W05ACA	"	*5 to 10 samples; some at 2 depths during study.*	"
Lake Five (17) Stations 1-2 (Sonstelie)	31N19W10ACC 31N19W10BAC	"	*8 samples, some at 2 depths during study*	"
Foy Lake (17) Stations 1-2 (Sonstelie)	28N22W26AAD 28N22W26ABC	"	*9 samples at 2 depths during study.*	"
Lk. Mary Ronan (17) (Sonstelie)	25N22W14CAD	"	*9 samples at 2 depths during study*	"
Rogers Lake (17) (Sonstelie)	27N23W30DAC	"	*7 samples during study*	"
Lower Stillwater Lake (17) (Sonstelie)	32N23W20DAA	"	*8 samples taken at 2 depths during study*	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
Swan Lake (17) Stations 1-3 (Sonstelie)	25N18W15AAD 26N18W30DAC 26N19W23AAB	July 1973 to June 1974	*9 samples at 2 depths during study*	*pH, Temperature, Conductivity, Light penetration, D.O., CO_2, HCO_3, CO_3, NO_3, T-PO_4, O-PO_4, Quantitative phytoplankton to genus*
Whitefish Lake (17) Stations 1-3 (Sonstelie)	31N22W24CDB 31N22W23DCB 31N22W04DBD	"	*13 samples at varying depths during study*	"
Canyon Creek (18) mouth N.F. Flathead R. (USFS)	Not Specified	7/15/69 to 9/10/69	Continuous	Water temperature (continuous thermographs)
Big Creek mouth, mid, & upper, N.F. Flathead (USFS) (18)	"	"	"	"
Coal Creek mouth, N.F. Flathead R. (18) (USFS)	"	"	"	"
Red Meadow Creek Lower, mid, upper N.F. Flathead R (USFS) (18)	"	"	"	"
Whale Creek mid-section, N.F. Flathead R. (18) (USFS)	"	"	"	"
Hay Creek, Lower, Mid, Upper, N.F. Flathead, R., Stations 1-3 (USFS) (18)	35N21W34DB 35N22W28CD (upper not specified)	July-Sept. 1969 July-Sept. 1970	Continuous	"
Hay Creek, Stations 2,4,5, N.F. Flathead (USFS) (18)	35N22W26DA 35N22W01BD 35N23W32DB	"	"	"
Hay Creek Trib. Stations 7,8, N.F. Flathead R. (USFS) (18)	35N22W23CC 35N22W04CB	"	"	"
Moran Creek, N.F. Flathead R. Sta. 9 (USFS) (18)	35N21W32DCB	"	"	"
N.F. Flathead R. nr. Columbia Falls (USFS-Delk) (19)	32N20W35BCA	May 1970 to Jan. 1973	*12 samples approx. each two months*	*Temperature, pH, Specific Conductance, Total Coliform, D.O. Turbidity, Alkalinity, Total Hardness, T.S.S. (all with field kit) Also 1 sample for: SiO_2, Al, Fe, Mn, Ca, Mg, Sr, Na, K, HCO_3, Alk. SO_4, Cl, F, NO_3, B, SAR, As, Be, Cr, Cu, Ni, Ag, T-PO_4, TDS, Color, Ba, Cd, Co, Pb, Mo, Se, CO_2*
N.F. Flathead R. @ Canada Border (USFS) (19)	In Canada, just north of Montana border	"	"	"
M.F. Flathead R. @ Bear Creek (USFS) (19)	29N15W31	May 1970 to April 1973	*10 samples somewhat random*	"

TABLE 11 Cont.

STATION NAME (AGENCY AND NO.)	LOCATION (1)	PERIOD OF RECORD	SAMPLING INTERVAL	WATER QUALITY PARAMETERS
M.F. Flathead R @ West Glacier (USFS) (19)	32N19W34ACC	Sept. 1969 to Jan. 1973	*13 samples somewhat random*	*Temperature, pH, S.C., Total Coliform, D.O., Turbidity, Alkalinity, Total Hardness, TSS, (all with field kit) Also one sample for: SiO_2, Al, Fe, Mn, Ca, Mg, Sr, Na, K, HCO_3, Alkalinity, SO_4, Cl, F, NO_3, B, SAR, As, Be, Cr, Cu, Ni, Ag, T-PO_4, TDS, Color, Ba, Cd, Co, Pb, Mo, Se, CO_2*
S.F. Flathead R. above Harrison Creek (USFS) (19)	24N14W08	June 1970 to June 1974	*11 samples somewhat random*	"
S.F. Flathead R. above Twin Creek (USFS) (19)	26N16W36ABA	Sept. 1969 to Aug. 1971	*10 samples somewhat random*	"
M.F. Flathead R. at Schaefer Meadows (USFS) (19)	27N13W23	June 1970 to June, 1974	*12 samples somewhat random*	*Temperature, pH, Specific Conductance, Total Coliform, D.O., Turbidity, Alkalinity, Total Hardness, TSS (all with field kit)*

FOOTNOTES - UPPER FLATHEAD WATER QUALITY STATIONS (TABLE)

(1) See appendix 3

(2) A National Eutrophication Survey station, sponsored by EPA and sampled by National Guard.

(3) Logan Creek Forestry-Water Quality Study, funded by U.S. Forest Service, Flathead National Forest; contract executed by Montana Dept. of Health and Environmental Sciences, Kalispell Regional Office.

(4) Montana Dept. of Health & Environmental Sciences, water quality base-line monitoring study, funded under contract by U.S. Corps of Engineers and Pacific Northwest River Basins Commission. Kalispell Regional Office.

(5) Montana Dept. of Health & Environmental Sciences, base-line water quality monitoring station. Kalispell Regional Office.

(6) U.S. Forest Service temporary water quality monitoring program, Stoner Creek drainage, 1973. Flathead National Forest.

(7) Occasional, ongoing U.S. Forest Service water quality sampling, remote areas, in conjunction with Montana Dept. of Health & Environmental Sciences-Flathead National Forest.

(8) Weber & Associates, Missoula, sediment and water quality contract study, funded by Office of Water Resources Research Center, Montana State University.

(9) Montana Division of Forestry, water quality sampling site, Missoula Regional Office.

(10) U.S. Geological Survey routine water quality monitoring station.

(11) U.S. Geological Survey, NASQAN station, slightly modified for Flathead 208 Project.

(12) Station sponsored by Flathead Drainage 208 Project, field assistance by Montana Dept. of Fish & Game, U.S. Geological Survey and other agencies.

(13) Montana Dept. of Fish & Game, base-line water quality monitoring data; Region 1, Kalispell.

(14) Data generated by University of Montana Biological Station at Yellow Bay.

(15) Jack Stanford Ph. D. Thesis "The Ecology and Life Histories of Plecoptera in the upper Flathead Rivers, Montana," Dept. of Biology, U. of Utah, Salt Lake City. (work done in conjunction with Yellow Bay BiologicalStation).

(16) Water quality stations by Tibbs, Gaufin & Stanford, data recorded in "Distribution and Biotic Effects of Nutrients in Flathead Lake, MT." (Jan. 1975), Yellow Bay Biological Station; study done under contract to Montana State Dept. Health and Environmental Sciences.

(17) Water quality stations by Lawrence Sonstelie, data found in "A Study of the Water Quality of 12 Lakes in the Flathead Drainage Basin," Flathead Valley Community College (1974) - project done under contract to Montana Dept. of Health andEnvironmental Sciences.

(18) U.S. Forest Service, Flathead National Forest, temperature study-logging effects. 1969-1970.

(19) U.S. Forest Service, Wild and Scenic Rivers study water quality sampling-Flathead National Forest.

IX. WASTE DISCHARGE PERMITS

The Montana state program of issuing waste discharge permits is operated under authority of the Montana Water Pollution Control Law. Statutory authority to apply and enforce state compliance schedules in state permits are Section 69-4806 (3), 4808.2 (1) and (2), 69-4820, 69-4820.1, and 69-4823, Revised Codes of Montana, 1947. The applicable rule is existing MAC 16-2.14(10)-S14460, Montana Pollutant Dischage Elimination System (MPDES), Section (2) (b) (ii), effective March 8, 1974.

Eight municipal and two industrial waste discharge permits have been issued by the State or E.P.A. in the Upper Flathead drainage basin. As one condition of these permits all municipalities on compliance schedules are expected to meet secondary treatment requirements by July 1, 1977. Facility descriptions and effluent characteristics are discussed in Section VI.

Federal permits are issued pursuant to the National Pollutant Discharge Elimination System (NPDES) created by the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA of 1972). To eliminate the duplication of effort which formerly existed, Montana was given the authority to administer the NPDES program in Montana on June 10, 1974. Section 402 of the FWPCAA of 1972 provides that states with adequate water pollution control program elements may apply for and receive authority from the E.P.A. to issue permits under the NPDES in their own states. Montana made the necessary revisions to the state water pollution control laws during the 1973 legislative session to provide the statutory authority for administration of the aforementioned NPDES program in Montana. In addition, the Board of Health and Environmental Sciences adopted a rule entitled the Montana Pollutant Discharge Elimination System (MPDES). The MPDES rule provides the additional program elements needed by the state to comply with rules and regulations promulgated by the administrator of E.P.A. pursuant to Section 304 (h) of the FWPCAA of 1972. Section 304 (h) relates to the state program elements necessary to administer the NPDES program.

TABLE 12 NPDES PERMITS IN THE UPPER FLATHEAD DRAINAGE BASIN (Current as of February 1, 1976)

FACILITY LOCATION (1)	NPDES PERMIT NO.	DATE ISSUED	EXPIRATION DATE	COMPLIANCE SCHEDULE
Kalispell Sewage Treatment Plant (3) (28N21W20CBB)	MT-0021938	5/6/74	3/31/77	9/30/74
Whitefish Sewage Treatment Plant (3) (30N21W05BC)	MT-0020184	9/16/74	6/30/79	7/1/77
Columbia Falls (3) Sewage Treatment Plant (30N20W18CDD)	MT-0020036	7/30/74	6/30/79	7/30/74 (in effect)
Bigfork Sewage Treatment Plant (3) (27N20W36BAD)	MT-0020397	9/16/74	6/30/79	7/1/77
Glacier Park Sewage Treatment Plant Lake McDonald Lodge (32N19W27AA)	MT-0020109	11/11/74	3/31/77	3/31/77 (to be abandoned)
University of Montana Biological Station Sewage Treatment Plant (24N19W04AAA)	MT-0023388	1/6/75	6/30/79	1/6/75 (in effect)
Hungry Horse Dam (3) Sewage Treatment Plant (30N19W22CDD)	MT-0022578	10/2/74	6/30/79	10/2/74 (in effect)
Big Mountain Sewage Treatment Plant (recently abandoned) (31N22W02AAD)	MT-0021377	12/27/74	6/30/76	1/1/76 (facility abandoned)
Burlington Northern Railroad, Whitefish (2) Oil treatment facility (31N22W36BAB)	MT-0000019	4/30/74	12/31/76	7/1/74 (in effect)
Creston National Fish Hatchery (2) (28N20W10DDD)	MT-0000086	4/25/75	12/31/79	7/1/77

(1) See Appendix C

(2) "Best Practicable Treatment" by date specified

(3) "Secondary Effluent" requirements by date specified

X. WASTE LOAD ALLOCATIONS

The entire upper Flathead drainage basin has been designated as "water quality limited", meaning that water quality standards would not be achieved even after all industrial and municipal wastes were given the equivalent of secondary treatment. The reason for the water quality limited designation was the documentation in recent years of increasing algal growths in Flathead Lake. Such algal growths are often associated with phosphate discharges in wastewaters. The basin was designated with the assumption that the phosphates could be removed from sewage discharges by requiring tertiary (nutrient removal) treatment.

Subsequently, studies were conducted by Tibbs, et al, (Ref. 9) in which it was determined that phosphates are indeed the algal growth limiting factor in Flathead Lake, but that sewage discharges carry less than 10% of the phosphates entering the lake. Thus, tertiary treatment, which ideally is only about 70% effective, could remove less than 7% of the phosphates entering Flathead Lake, and this at a cost of perhaps two to three million dollars. Section VIII now revises the sewage load to only 5% of the total.

In view of the above considerations, the "water quality limited" designation for the Flathead drainage will remain, but it would be quite useless and very expensive at this time to require waste load allocations.

As waste load allocations can be applied only to point discharges, and as the phosphate sources appear to be of non-point origin, no allocations will be attempted at this time. Efforts should be made, however, to further define the sources of the nutrients, as has been done only to the level of major tributaries in Section VIII of this report. Once sources have been identified, it may be possible to reduce them by using non-point control technologies. This has been identified as a further study need in Section XIII of this report.

Earlier discussions of ammonia toxicity (pp 49-50) pointed out that maximum EPA recommended levels of NH_3-N are thought to be occurring in the Whitefish River, and much higher levels are occurring in Ashley Creek. For the purposes of this plan, the Whitefish River is not designated as water quality limited, but the situation must be reviewed when revisions are made. In the interim, ammonium, pH and temperature measurements will be added to the state monitoring network both in the Whitefish River and Ashley Creek. Ammonia concentrations well over EPA recommended levels are occurring in Ashley Creek, but water quality standard violations are not resulting because Ashley Creek is classified E-F, a very low quality stream, suitable for agricultural and industrial (non-food processing) uses only. The ongoing 208 study may recommend upgrading the Ashley Creek standards, and if so the stream would require a "water quality limited" designation and waste load allocations. This, in turn would require ammonia reduction from the Kalispell sewage plant effluent.

XI. MANAGEMENT, STRATEGY AND SURVEILLANCE PLAN

MANAGEMENT STRATEGY

The objective of water quality management is to maintain or enhance the quality of waters within the basin. To accomplish this, management programs and plans must be developed and implemented within the basin. After development and implementation, waters and wastewaters in the basin must be checked to determine actual effectiveness of the management program. Water quality management is an interative process; that is, a plan must be followed, the results checked, the plan modified and the results again checked. A management strategy contains a number of elements. These are:

1. Permits

   State and federal pollutant discharge permits are a basic tool in regulating the discharge of effluents to state waters. All discharges under the permit authority, either are or will be permitted or eliminated. The permit program regulates the quantity and quality of discharges of municipal and industrial wastes and certain agricultural wastes, including discharges from confined feeding operations and from irrigation drainage systems. The discharge permit is also used to regulate effluent from new or expanded discharges. As stream quality data are obtained, the permit can be used to insure that discharging effluents do not cause streams to exceed state water quality standards. All dischargers will be required, under the permit program, to achieve best practicable control technology not later than July 1, 1977. All publicly owned treatment works must achieve secondary treatment by July 1, 1977.

2. Intensive Surveys

   Intensive water quality surveys are conducted for waters in the basin that have water quality problems. Objectives of intensive surveys are to determine pollution causes and potential means of elimination or abatement of pollutants. As additional water quality problems are identified within the basin, intensive surveys will be made. Intensive surveys also are conducted to determine the impact of specific wastewater discharges, land practices, or water treatment facilities that are installed in the basin.

3. Monitoring

   Monitoring includes a number of activities that provide measurement of chemical, physical and biological quality of water and changes in quality. Monitoring includes:

   (a) self-monitoring required by dischargers that are under the Pollutant Discharge Elimination System permit program

(b) compliance monitoring by the Water Quality Bureau and the EPA to ensure that permitted discharges are in compliance with allowable limits:

(c) periodic sampling and analysis of water at selected stations;

(d) aerial and ground observations of basin waters and practices or facilities that affect water quality;

(e) the use of continuous water quality recording instrumentation to obtain a continuous record of selected water quality parameters;

(f) short-duration surveys of stream segments to determine changes in quality in streams as the water progresses downstream;

(g) evaluation of water quality data to determine trends and to identify problems.

The basic objective of the monitoring effort is to determine the status of water quality and to determine variations in water quality. The monitoring network also is useful for determining the impact of activities within the basin that influence water quality. Such activities include those that potentially degrade water quality, such as logging, wastewater discharges, earth moving activities and certain agricultural practices; and those activities that may enchance water quality, such as installation of improved treatment facilities.

4. Facilities Construction, Operation and Maintenance

Federal and state grant programs are available to assist municipalities in the construction of sewage treatment facilities, which include outfall and interceptor sewers. Such facilities provide improved treatment of wastewaters and reduce the impact of wastewaters on the receiving water body. An integral part of the waste treatment facility program is adequate operation and maintenance of the facilities after construction is completed. The state requires that all operators be certified and the state provides technical assistance and annual schools for operators.

5. Operation and Maintenance

Periodic inspections are made of municipal and industrial wastewater treatment facilities in the basin. The objective of operation and maintenance inspections is to ensure that waste treatment facilities are operated in a manner that provides the best possible treatment.

6. Information and Education

Information is made available to the public through bureau publications, talks, technology transfer seminars and through answering inquiries. Public hearings and environmental impact

statements are presented for important or controversial issues in the basin. Information and educational efforts are informing the public of water quality conditions in the basin and factors that can degrade water quality. This effort stresses development of a pollution prevention attitude.

7. Regulations and Guidelines

To prevent water quality degradation within the basin, regulations and guidelines that relate to water quality will be made available to residents of the basin through state and county organizations. This includes regulations that influence water and wastewater from subdivisions and private and public water and wastewater facilities. In addition, existing regulations may be changed or updated to control activities within the basin that will degrade water quality. The Department of Health and Environmental Sciences, in cooperation with other agencies, will develop guidelines that will abate or eliminate pollution resulting from storm drainage, storm sewer discharges and non-point sources, including irrigation practices, road building, construction , logging practices, overgrazing and other practices. Land use is recognized as a dominant factor controlling water quality in the basin. Those activities which influence land use will be examined to determine how water quality degradation due to improper land uses can be eliminated or abated.

8. Enforcement

Violations of Montana's laws, rules, or permits are investigated and are subject to injunction, civil penalities or criminal penalities. The rules and regulations upon which enforcement is based are periodically reviewed and updated to insure that Montana's laws and regulations are adequate and can be properly enforced.

9. Program Coordination

Montana's water pollution control program will be coordinated with other state, federal and local agencies to ensure that the activities of these groups receive adequate information with respect to their water quality related activities. This includes review of proposed programs, laws, regulations and proposed technical investigations that relate to water quality.

The elements of basin water quality management described above generally are applicable to all basins. Specific steps that will be taken in the Upper Flathead River basin are:

1. Permits

Permit conditions and progress in meeting compliance schedules will be reviewed for all dischargers in the basin in FY 1976. All permits will be reviewed prior to expiration to determine what revisions are needed for the reissued permits. All dischargers that are under the NPDES or MPDES, have currently received discharge permits.

2. Intensive Surveys

As water quality problems are identified and as funding is available, intensive surveys will be conducted. Potential areas for such surveys include Ashley Creek and the Whitefish and Stillwater Rivers. Some of these surveys may be conducted by the Flathead Drainage 208 Project.

3. Facilities Construction, Operation and Maintenance

Inadequate municipal sewage treatment has been ranked according to priority (Appendix 4) and will be upgraded to meet secondary treatment by July 1977. Industrial treatment of wastewater discharges will meet best practicable treatment by July 1977. Some EPA and state grant funds will be available for municipal sewage facilities. Sewage treatment plant operator training and the operators school will be available for municipal sewage facilities. Sewage treatment plant operator training and the operators school will be available for the basin.

4. Operation and Maintenance

At least one inspection will be made annually of each municipal sewage treatment facility in the Upper Flathead River basin. Critical installations will be provided additional inspections when needed and facilities with special operation and maintenance problems will be provided with technical assistance. Major industrial dischargers are examined at least twice per year and minor dischargers are examined as needed and as manpower and funding are available.

5. Information and Education

The general bureau information and education program will be utilized in the basin. No specific basin programs are planned for the next year.

6. Regulations and Guidelines

During the next year the regulatory framework for water pollution control will be reviewed by the bureau legal staff. The adequacy of the regulations to prevent pollution will be assessed.

7. Enforcement

Enforcement actions will be taken as needed for prosecution of violations of the state's water pollution laws and regulations.

8. Program Coordination

Federal, state and private organizations that have water quality related activities in the basin will be informed of the bureau's efforts and will be requested to furnish information on these basin programs.

MONITORING AND SURVEILLANCE

Water quality monitoring and surveillance programs represent a major investment of time and funds. Such programs should obtain the needed information at least cost. To properly design a cost-effective monitoring system, a number of factors must be considered including:

1. Adequacy of baseline data in the basin

2. Status of the stream as receiving water for pollutant discharges

3. Data needs for point source discharges under state and federal permit programs

4. Existing and potential water quality problems

5. Data needs for enforcement actions

6. Available time and funding

7. Existence of other water quality data collection programs in the area.

Flexibility in scope and intensity is an important aspect of a proposed program. A variety of factors can influence an area's water quality; these include industrial, municipal and agricultural developments, federal and state regulations and water transfers. With the range of developments that can occur in a basin, a long-term management strategy cannot be efficiently developed. Water quality surveillance and monitoring is directed at short-term conditions (up to five years in the future) and is revised annually.

Monitoring and surveillance recommendations are presented in this report. The detailed basin monitoring and surveillance program is developed by the Water Quality Bureau as part of the annual water pollution control program plan. Monitoring and survillance activities are conducted by a variety or organizations including communities and industries, federal and state agencies, private individuals and organizations. Commonly, acute problems such as toxic conditions causing fish kills, oil spills, etc. are recognized by basin residents or persons working in the basin.

The following is the recommended monitoring program for the Upper Flathead River basin:

1. Compliance Monitoring

   It is recommended that the following point discharges be checked by the Water Quality Bureau to check compliance with permit conditions.

Kalispell STP

Columbia Falls STP

Glacier National Park (Apgar) STP

Whitefish STP

Bigfork STP

Hungry Horse Dam STP

U. of Montana Biological Station STP

Creston National Fish Hatchery

Suspended solids, BOD_5, fecal coliforms and flow will be monitored in all municipal discharges; residual chlorine will be measured where chlorination is provided.

Similarly, it is recommended that the following industrial discharges be monitored by the Water Quality Bureau to check compliance with permit conditions:

Burlington Northern Railroad, Whitefish

Anaconda Aluminum STP (non-overflow)

Glacier Park Co., Somers (non-overflow)

Frequency and parameters to be monitored for irrigation and other non-point discharges have not, as yet, been defined. Feedlots are designed basically as non-discharging facilities.

2. Self-Monitoring

All waste dischargers under MPDES permit are required to periodically sample and analyze their wastewater and report these results to the Bureau and the Environmental Protection Agency. The parameters to be monitored are specified in the conditions of the permit.

3. Water Quality Surveillance Network

As a portion of the statewide water quality surveillance network, six stations have been established for monitoring in the Upper Flathead drainage basin. The stations are described in the Montana Water Pollution Control Program Plan for fiscal year 1976 (Ref. 3) and are located as follows:

(a) Flathead River at Holt Bridge (27N20W23BCA)-this station provides an overview of the water quality of the entire Flathead River drainage, just upstream of its entrance into Flathead Lake. Samples are collected quarterly and analyzed for nutrients and total suspended solids.

(b) Ashley Creek just above (28N21W20BCC) and just below (28N21W29BAB) the Kalispell sewage treatment plant. These stations are monitored quarterly for nutrients and fecal coliform bacteria, to provide a water quality measurement of the effects of the Kalispell sewage treatment plant on Ashley Creek. In addition, ammonia and pH will be measured.

(c) Whitefish River near Kalispell (30N21W34BDC). This station, near Glacier International Airport, provides basic water quality monitoring for activities in the Whitefish drainage. Nutrients and fecal coliform are analyzed quarterly. These parameters provide a downstream indication of how well the Whitefish sewage lagoon is operating. Also, biological samples (benthos) are collected once per year to provide a biological indication of water quality at this point. In addition, ammonia and pH will be measured.

(d) Stillwater River near Kalispell (28N21W08BBB). This station, at the old Northwest Dam bridge, is sampled annually for benthos, to detect changes in the suitability of the river for bottom dwelling organisms.

(e) North Fork Flathead River near Canadian border (37N22W05ADD). This station is sampled annually for benthic organisms to detect long term biological changes. More detailed biological sampling is provided at this station by the U.S. Geological Survey, operating a NASQAN station near the site.

4. Aerial and Ground Surveys

Examination of streams and water bodies is done as part of the routine bureau visits in the basin. Other agencies and organizations also commonly notice stream conditions during their basin trips. Detailed aerial surveillance and actual stream examination on foot or by boat may be required for selected problems.

5. Data Interpretation and Analysis

Surveillance and monitoring activities develop water quality data that must be compared with previous data, water quality standards, permit conditions, etc. Results of water quality testing must be analyzed and interpreted to understand temporal and spatial changes in water quality and determine if the sampling network is adequate to meet program objectives.

XII. MUNICIPAL FACILITIES INVESTMENTS

State water quality standards in the Upper Flathead drainage probably will not be violated by municipal discharges after the application of secondary treatment and the upgraded treatment provided by Kalispell and Yellow Bay. Ashley Creek below Kalispell possibly should be upgraded in classification (present E-F), but this must await collection of additional data and improved operation of the Kalispell sewage plant. Also, with a guaranteed minimum flow to support a year-round sport fishery, upgrading would be warranted.

The amounts of nutrients entering Flathead Lake at the present time from the upstream municipalities does not appear to warrant nutrient removal. However, a close watch needs to be maintained on Flathead Lake to assure that this condition does not change and facilities being designed for secondary treatment need to have adequate consideration so nutrient removal can be easily added in the future. Table 13 summarizes the needs, costs and priorities of proposed projects in the basin. Projects are assigned a statewide priority based on an evaluation system established by the Water Quality Bureau. The system for allocation of federal grants to municipalities for sewage works is based on severity of pollution problems, population affected, need for preservation of pure waters and national priorities. To date, no facility plans in the basin have been completed and approved although plans for Bigfork and Whitefish are near completion. Costs presented should be considered as rough estimates. In addition to the communities shown as having needs in Table 13, there are other communities which should be more completely assessed. These are: Hungry Horse, Martin City, Coram, West Glacier and Big Arm. These all have population densities and substantial tourist accommodations which could cause problems to arise with subsurface disposal facilities. A high cost for providing facilities in these communities (probably exceeding $500,000 per community) will deter construction unless substantial problems arise. It is suggested that the Flathead Drainage Basin 208 Project provide a field review to determine if there are any apparent problems with present disposal practices in these communities and whether facility planning should be pursued.

A sewer around the perimeter of Flathead Lake has previously been suggested by some of the residents in the area. A very rough estimate of the cost of a perimeter sewer is 13 million dollars (Ref. 5). Such a sewer would allow extensive development around the lake solving any sewage problems on the lake, but which would undoubtedly create much greater water quality problems through the additional change in land use and construction that would take place. A more realistic approach would appear to be the sewering of selected areas where the change in land use and new construction would create a few water quality management problems.

TABLE 13 MUNICIPAL SEWERAGE NEEDS IN UPPER FLATHEAD BASIN

COMMUNITY AND PRIORITY NO.	NEEDS DESCRIPTION	ESTIMATED LOAD (P.E.)	COST ESTIMATE	STATUS
City of Kalispell (114)	Storm sewer separation	Unknown	$2,000,000	Planning well developed
Evergreen & Woodland Park areas near Kalispell (76)	Collection sewers and interceptor sewer to City of Kalispell	3,700	Collector sewers= $ 360,000 Interceptor sewers= $1,200,000	No action taken to date
City of Whitefish (9)	Upgraded treatment facilities to meet secondary treatment requirements	3,400	$1,380,000	201 facility planning in progress
	Interceptor and collector sewers to serve areas along lake & Big Mountain complex, and storm sewer separation	1,000	Collector sewers= $ 264,000 Interceptor sewers= $ 877,000 Storm sewer separation $ 80,000	
Community of Bigfork (15)	Upgrading of existing treatment facility and land disposal of effluent. Infiltration reduction	500	Upgrading treatment= $ 534,000 Infiltration reduction= $ 30,000	201 facility planning in progress
City of Columbia Falls (no priority rating)	Minor improvements of majority of treatment plant and substantial improvement of sludge handling facility.	2,000	$ 50,000	Some improvements in progress. May not request construction grant funds.

TABLE 13 Cont.

COMMUNITY AND PRIORITY NO.	NEEDS DESCRIPTION	ESTIMATED LOAD (P.E.)	COST ESTIMATE	STATUS
Community of Elmo (no priority rating)	Reduction of extraneous water entering sewer system	150	$5,000	Not available
Community of Lakeside (78)	Collection sewers, interceptor sewers & sewage treatment	600	No estimate available	Preliminary report completed several years ago. Need for facility plan to be investigated under Section 208
Community of Somers (no priority rating)	Collection sewers, interceptor sewers & sewage treatment	800	No estimate available	Need for facility plan to be investigated under Section 208
Community of Swan Lake (89)	Collection sewers, interceptor sewers & sewage treatment	300	No estimate available	Need for facility plan to be investigated under Section 208

XIII PLANNING NEEDS

Water quality planning in the upper Flathead drainage has traditionally revolved around the eutrophication of Flathead Lake and the effects of point sewage discharges. More recently, forestry practices, Hungry Horse Dam operations and animal feedlots have received some attention. Very recently, just prior to the establishment of the Flathead Drainage 208 Project, oil and gas exploration and coal development along the North Fork Flathead drainage was announced, causing considerable re-shuffling of planning priorities. Very little was known about water quality in the North Fork, but the very timely establishment of the 208 project filled the study void nicely. However, the 208 project is funded for only two years, and only one of those years can be devoted to data gathering. Following the autumn of 1976, only one water quality station will continue to operate in the North Fork Flathead drainage, it being the U.S.G.S. NASQAN station at the Canada border. With major coal developments, potential oil and gas developments, and international attention focused on the North Fork, it is considered imperative that extensive water quality data gathering be continued there. At present, there is no sponsor which has indicated an interest in funding such a program, although several state and federal agencies have made these needs known.

The operations of Hungry Horse Dam cause fluctuations in water levels and temperatures in the Flathead River between Hungry Horse and Flathead Lake. The temperature variations effect aquatic insects markedly as demonstrated by Stanford (Ref. 7), and Fish and Game personnel have observed adverse effects on fish spawning runs. The problem needs a detailed study with emphasis on fishery effects. The Flathead Drainage 208 Project will be studying the problem to some extent, but low level funding will not allow a study of the fishery. The Montana Dept. of Fish and Game has proposed such a study to the Bureau of Reclamation, but no funding has been made available. It is recommended that a study of the fishery of the Flathead River below Hungry Horse be conducted to determine to what extent the flow and temperature variations from the Dam are affecting fish populations, migrations and spawning success. On the federal level, means of correcting the flow and temperature problems should be investigated. Feasibility studies would be in order for operational changes at the dam and for construction of a variable level intake and a reregulation dam for flow control.

The concern with nutrients and eutrophication of Flathead Lake is still present. It is recommended that limnological studies continue, to keep abreast of the trophic status of the lake and to provide advance warning of serious problem conditions. It is also recommended that the phosphate source investigation attempted in this report be continued in greater detail to identify which drainages, and which activities within those drainages, are supplying the bulk of the nutrients to Flathead Lake. Means of controlling such nutrients should be investigated.

It is important, in future nutrient studies, that low detection limit techniques be used to measure the phosphate concentrations as accurately as possible. Wet chemistry methods (Standards Methods, stannous chloride procedure) have lower detection limits which are a little too coarse for detailed nutrient budget work in high quality waters.

Dewatering of Ashley Creek and the Whitefish and Stillwater Rivers, is becoming an increasing problem. New wells and surface intakes are being installed at an alarming rate. These streams all have flat gradients and pose natural sedimentation and temperature problems to fish. Dewatering activities are compounding these problems. Physical fish passage has become a problem in some areas. It would seem that an investigation would be in order to assess future irrigation needs and the effects this will have on the fisheries of the three streams. Recommendations are needed for minimum flow reservations for fish, although the streams are already over-appropriated. The feasibility of increasing streamflows artificially, such as by the Triangle Plan, should be reevaluated periodically to determine economic feasibilities.

Groundwater pollution in Evergreen is one of the most talked about, least studied aspects of water pollution in the upper Flathead drainage. The basic questions that need answering include:

1. What is the extent of groundwater pollution in Evergreen?

2. What happens to the nutrients in the porous soil? Do they eventually enter Flathead Lake? Is this a significant problem?

3. Would tougher septic tank regulations alleviate any problems?

4. What is the feasibility of a sewer system? Would it be justified?

The Flathead Drainage 208 Project will be studying the problem in a contracted groundwater study. After the completion of that study, it would be worthwhile to assess whether or not these basic questions have been answered.

Forestry practices are strictly regulated on federal lands which support the bulk of the logging activity in the Flathead drainage. Relatively little actual water quality work has been done in this area, however, to determine just which activities are good, which are bad, and to what degree. The "in" field of study now seems to be predictive modeling, whereby water quality or sedimentation problems can be predicted before the logging activities commence. It is recommended that support be given such modeling efforts. If the results prove to be of questionable value, the program should be discarded, but if predictive modeling does indeed work, the basic data needed for the models should be collected throughout the basin, and used as a management tool. This topic will be investigated to some extent by the Flathead Drainage 208 Project.

Water quality problems and needs for the Flathead River Drainage are summarized in Table 14.

The order of priorities for the problems and needs of Table 14 with highest priority first, are as follows:

1. Degradation, North Fork Flathead
2. Hungry Horse Dam Problems
3. Dewatering White, Stillwater, Ashley
4. Ashley Creek Pollution
5. Forestry Problems
6. Flathead Lake Eutrophication
7. Small Lake Eutrophication
8. Evergreen Groundwater

TABLE 14. SUMMARY OF WATER QUALITY PROBLEMS IN UPPER FLATHEAD DRAINAGE BASIN

WATER QUALITY PROBLEM	CAUSE AND SEVERITY	STREAM SEGMENT OF AREA	STREAM OR SEGMENT CLASSIFICATION	PERIOD PROBLEM IS MOST PREVALENT	PROBLEM STATUS	ADDITIONAL WORK NEEDED	METHODS FOR CORRECTION	ESTIMATED COST FOR CORRECTIVE ACTION	TIME FOR SOLUTION OF PROBLEM AFTER CORRECTIVE ACTION
Potential degradation of N.F. Flathead River	Canadian coal mining proposal and potential oil and gas development in Montana. Potentially serious problems.	Flathead River, Canadian border to Flathead Lake. Approximately 90 miles of river.	$B\text{-}D_1$	Problem has not yet developed. Most serious problems anticipated during spring runoff and during summer low flows.	Problem has not yet occurred and with proper controls may not become serious	Continued monitoring of water quality after termination of 208 effort in fall of 1976 is considered essential. Funding is not presently available for this monitoring.	Source controls to prevent erosion or to treat process waters.	No estimate available.	Indeterminate at this time.
Temperature and flow fluctuations, Flathead River below Hungry Horse	Operations at Hungry Horse Dam. Severity not fully established but effects appear to be substantial on fish migration and spawning success. Temperature variations are presently severe.	Flathead River from Hungry Horse to Flathead Lake. Also S.F. Flathead River below dam. Probably also affects Flathead Lake.	$B\text{-}D_1$ (Rivers) and A-D Open-D_1 (Lake)	Essentially every season except spring	Hungry Horse Dam is operated with no provisions for the environment or for recreation. Some feasibility work has been done by Bur. Rec.	A study is needed to assess the biological effects on the Flathead River particularly on fish spawning and migration. Such a study is being proposed by MT Fish & Game and independent biologists. Additional feasibility work needed on regulation dam and multi-level intake.	Change in operations of dam.	Not known, but effects on power generation could be substantial.	Solution would not be complete, but would be nearly instantaneous.
							Construct multi-level dam intake to draw warmer water through dam.	Approximately $5 million.	Temperature problems would be corrected Almost instantly.
							Construct downstream dam to reduce flow fluctuations in S.F. Flathead River.	Costs not known. Probably several million dollars, if dam site is feasible at all.	Solution would depend on size of afterbay and operating expertise. Solution would be partial, but time lag would be short.

TABLE 14. SUMMARY OF WATER QUALITY PROBLEMS IN UPPER FLATHEAD DRAINAGE BASIN

WATER QUALITY PROBLEM	CAUSE AND SEVERITY	STREAM SEGMENT OF AREA	STREAM OR SEGMENT CLASSIFICATION	PERIOD PROBLEM IS MOST PREVALENT	PROBLEM STATUS	ADDITIONAL WORK NEEDED	METHODS FOR CORRECTION	ESTIMATED COST FOR CORRECTIVE ACTION	TIME FOR SOLUTIO OF PROBLEM AFTER CORRECTIVE ACTIO
Water quality effects of forestry practices. Sedimentation and increases in temperature and nutrients.	Logging practices; severity depends largely on individual practices. May be very severe to barely detectable.	Nearly all streams in drainage where logging is not prohibited.	Mostly B-D_1	Spring runoff period (sedimentations and nutrients) and late summer (thermal increases)	Improved forestry practices on federal lands have reduced problems. Nutrient contributions basin-wide probably not too significant.	Improved predictive modeling techniques applied to management practices. Additional low-detection limit nutrient work needed to assess the problem.	Many methods known, the most important of which is keeping heavy equipment and operations well away from the streams.	No estimate known. The solution is a management problem which is difficult to assess economically.	In areas already affected, sediment problems will heal in perhaps three years and temperature and hydrogical problems in perhaps twice that long.
Eutrophication of Flathead Lake.	Cause primarily phosphate inputs from non-point sources in lower valley.	Flathead Lake, 183 square miles surface area.	A Open-D_1	Late Summer	Problem not serious, but increasing incidence of algal blooms has been documented.	Low-level detection techniques needed to refine phosphate budget to better define sources of those nutrients. Once defined, methods for controlling nutrient losses to the system should be investigated. Also, monitoring should continue in Flathead Lake to keep abreast of its trophic status.	While the problem appears to be non-point, sources in the lower valleys, correction technology must await better definition of sources.	Not known at this time.	Trophic status of a lake from which nutrient input has been reduced may not change markedly for two or three years.

TABLE 14. SUMMARY OF WATER QUALITY PROBLEMS IN UPPER FLATHEAD DRAINAGE BASIN

WATER QUALITY PROBLEM	CAUSE AND SEVERITY	STREAM SEGMENT OF AREA	STREAM OR SEGMENT CLASSIFICATION	PERIOD PROBLEM IS MOST PREVALENT	PROBLEM STATUS	ADDITIONAL WORK NEEDED	METHODS FOR CORRECTION	ESTIMATED COST FOR CORRECTIVE ACTION	TIME FOR SOLUTION OF PROBLEM AFTER CORRECTIVE ACTION
Impaired water quality of lower Ashley Creek; growth of algae and duckweed; ammonia toxicity; oxygen depletion.	Primarily the result of Kalispell sewage treatment plant discharge to the creek.	Ashley Creek from County Airport to Flathead River; approximately 8 miles of stream.	E-F	Low flow period; late summer.	Status fairly stable. Improved effluent from sewage plant may help, but problem is mainly one of nutrients, which are not removed at this plant.	Additional water quality monitoring in lower Ashley Creek during late summer, for NH_3, DO, TVSS, assessment of sludge deposits.	Only viable solution is to remove discharge from creek entirely. Either spray irrigate or pipe to Flathead River.	Outfall to Flathead River probably in the order of one million dollars.	Sludge deposits in creek may slow recovery of stream. Perhaps 2 or 3 years before substantial recovery.
Dewatering of Whitefish & Stillwater Rivers and Ashley Creek. Inadequate dilution of wastewaters, and physical barriers to fish passage.	Agricultural withdrawals. Problem severe in all three streams.	Ashley Creek, lower 10 miles; Whitefish River, lower 15 miles; Stillwater River, lower 15 miles.	Ashley Creek, B-D_2 and E-F; Whitefish River, B-D_2; Stillwater River B-D_2	Irrigation season; late summer.	Worsening fairly rapidly as more water is being drawn from stream and nearby irrigation wells. At present, some seasonal barriers prevent fish passage.	Irrigation needs for the future should be quantified, and the impact on water quality and aquatic biology should be assessed.	Flow reservation for fishery benefits.	Not known. Costs would be indirect and would appear as reduced agricultural crop yields.	No time lag expected.
							Flow augmentation by "Triangle Plan" using Flathead River water.	$1,788,000	No time lag expected after construction completed.

TABLE 14. SUMMARY OF WATER QUALITY PROBLEMS IN UPPER FLATHEAD DRAINAGE BASIN

WATER QUALITY PROBLEM	CAUSE AND SEVERITY	STREAM SEGMENT OF AREA	STREAM OR SEGMENT CLASSIFICATION	PERIOD PROBLEM IS MOST PREVALENT	PROBLEM STATUS	ADDITIONAL WORK NEEDED	METHODS FOR CORRECTION	ESTIMATED COST FOR CORRECTIVE ACTION	TIME FOR SOLUTIC OF PROBLEM AFTEF CORRECTIVE ACTIC
Groundwater pollution, Evergreen area.	Septic tank use in high groundwater areas.	Approximately 4,000 acres, estimated.	N.A.	During spring runoff, especially in high runoff years.	Relatively static. Extent of problem not well defined. 208 project to address problem.	Extent of problem needs better definition. Health effects and effects on Flathead Lake need to be quantified.	Sewer system for Evergreen area.	$1,560,000	Probably six months or less.
Eutrophication of smaller lakes including Lake Mary Ronan, Echo Lake, Foy Lake, Lake Blaine and Rogers Lake.	Primarily shoreline subdivision and development, logging activity and cattle grazing along shoreline or in watershed.	Drainage Basin Areas: Lake Mary Ronan = 32 square miles; Echo Lake = 14 sq. miles; Foy Lake = 5.0 sq. miles; Lake Blaine = 5.6 sq. miles; Rogers Lake = 4.4 sq. miles.	$B\text{-}D_1$	Late summer.	Eutrophication is becoming more pronounced in all lakes listed. Rate of increase has not been measured.	In these lakes the proportionate contributions of nutrients from the several sources need to be assessed. Without such information, it is difficult to recommend controls.	Sewage systems: Relocate back from shoreline or intercept with sewer system. Cattle: Fence away from lakes and tributary streams and provide alternate water for cattle. Logging: Careful logging practices, leaving green strips along lake and stream shorelines.	Costs have not been assessed.	Changes in trophic status of lakes would lag perhaps two years behind controls of nutrient influence.

APPENDIX I

GLOSSARY

Symbol	Definition
BOD_5	Five-day biochemical demand
cfs	Cubic feet per second
gpcd	Gallons per capita per day
gpd	Gallons per day
gpm	Gallons per minute
JTU	Jackson turbidity unit
lbs/capita/day	Pounds per capita per day
lbs/day	Pounds per day
ml	Milliliter
mgd	Million gallons per day
mg/l	Milligrams per liter
sq. ft.	Square feet
TR	Total recoverable
tpd	Tons per day
μmhos	Micromhos per centimeter
$<$	Less than
$\leq$	Less than or equal to
$\geq$	Greater than or equal to
$\sim$	Approximately
BPT	Best practical treatment
WQB	Montana Department of Health & Environmental Sciences, Environmental Sciences Division, Water Quality Bureau
F & G	Fish and Game, Montana Department of
MDHES	Montana Department of Health & Environmental Sciences
MPDES	Montana Pollutant Discharge Elimination System
NPDES	National Pollutant Discharge Elimination System
BuRec	Bureau of Reclamation
EPA	U. S. Environmental Protection Agency
NOAA	National Oceanographic and Atmospheric Administration
SCS	U. S. Department of Agriculture, Soil Conservation Service.
USGS	U. S. Geological Survey
USPHS	U. S. Public Health Service

APPENDIX 2

MONTANA STATE DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

MAC 16-2.14(10)-S14480 WATER QUALITY STANDARDS

(1) Policy statement. The following standards are adopted to establish maximum allowable changes in water quality and establish limits for pollutants which affect prescribed beneficial uses of state waters. The department adopts as a rule the policy that best practicable treatment and control of waste, activity and flow is to be provided to maintain dissolved oxygen and overall water quality at the highest possible levels, and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor and other deleterious substances at the lowest possible levels.

(2) Application of standards. The water quality standards are composed of water-use classifications [section (4)], water-use descriptions and specific water quality criteria [section (5)], and general water quality criteria [section (6)].

(a) General water quality criteria apply to all state waters except where in this rule specific water quality criteria are more applicable to a specific water-use classification.

(b) In order to carry out the objective of the rule, existing discharges to state waters shall be brought into compliance with the standards as soon as practicable, and in no case later than three years from the effective date of the rule.

(3) Definitions. Unless statutory definition or the context otherwise requires in this rule:

"Conduit" means any artificial or natural duct, either open or closed, for conveying liquids or other fluids.

"Dewatered stream" means a perennial or intermittent stream whose water has been removed for one or more beneficial uses.

"EPA" means the U. S. Environmental Protection Agency.

"Intermittent stream" means a stream or portion of a stream that flows only in direct response to precipitation; it receives little or no water from springs and no long-continued supply from melting snow or other sources.

"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Conditions resulting from dams in existence as of July 1, 1971 are natural.

"Mixing zone" means that volume of state water wherein any pollutant may exceed allowable water quality standards.

"Pesticide" means insecticides, herbicides, rodenticides, fungicides or any substance or mixture of substances intended for preventing, destroying, controlling, repelling, altering life processes, or mitigating any insects, rodents, nematodes, fungi, weeds and other forms of plant or animal life.

"Residue" means oils, floating solids and sludge deposits.

"Sediment" means solid material settled from suspension in a liquid; mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest on the earth's surface, either above or below sea level; or inorganic or organic particles originating from weathering, chemical precipitation or biological activity.

"Settleable solids" means inorganic or organic particles that are being transported or have been transported by water from the site or sites of origin and are settled or are capable of being settled from suspension.

"Sewer" means a pipe or conduit that carries wastewater or drainage water.

"State waters" means any body of water, irrigation system or drainage system, either surface or underground. This section shall not apply to irrigation waters where the waters are used up within the irrigation system and said waters are not returned to any other state waters. The term "state waters" as used in this rule does not include underground water.

"Storm sewer" or "storm drain" means a sewer that carries storm water and surface water, street wash and other wash waters, or drainage but excludes sewage and industrial wastes.

"True color" means the color of water from which the turbidity has been removed.

"Turbidity" means a condition in water or wastewater caused by the presence of suspended matter resulting in the scattering and absorption of light rays.

(4) Water-use classifications.

Flathead River:

Flathead River drainage (except tributaries in Glacier National Park or in nationally designated wild, wilderness or primitive areas) except tributaries and lakes or reservoirs listed below . . . . . B-D_1

Essex Creek drainage to the Essex water supply intake . . . A-Closed

Remainder of Essex Creek drainage . . . . . B-D_1

Snyder Creek (mainstem) through the community of Lake McDonald in Glacier National Park to Lake McDonald . . . . B-D_1

Stillwater River (mainstem) from but excluding Logan Creek to the Flathead River . . . . . B-D_2

Whitefish Lake and its tributaries . . . . . A-Open-D_1

Whitefish River (mainstem) from the outlet of Whitefish Lake to the Stillwater River . . . . . B-D_2

Haskill Creek drainage to the Whitefish water supply intake . . A-Open-D_1

Remainder of Haskill Creek drainage . . . . . B-D_1

Remainder of Whitefish River drainage . . . . . B-D_1

Remainder of Stillwater River drainage . . . . . B-D_1

Ashley Creek drainage to and including Smith (Kila) Lake . . . . B-D_1

Ashley Creek (mainstem) from Smith Lake to bridge crossing on the airport road about one mile south of Kalispell . . . . . B-D_2

Ashley Creek (mainstem) from bridge crossing on airport road to the Flathead River . . . . . E-F

All tributaries to Ashley Creek from Smith Lake to the Flathead River . . . . . B-D_1

Flathead Lake and its tributaries except Flathead River above the lake (as listed above), Swan River and portions of Hellroaring Creek as listed below, but including Swan Lake proper and Lake Mary Ronan . . . . . A-Open-D_1

Swan River drainage (except Swan Lake proper) . . . . . B-D_1

Hellroaring Creek drainage to the Polson water supply intake . . . . . A-Closed

Remainder of Hellroaring Creek drainage . . . . . B-D_1

(Simply as a note for clarification, the Flathead River below the highway bridge at Polson to Paradise is included in the B-D_1 classification of the Flathead River drainage listed above.)

Crow Creek drainage to road crossing at Section 16, T20N, R20W about 2.5 miles southwest of Ronan except the portion of Second Creek listed below . . . . . B-D_1

Second Creek drainage to the Ronan water supply intake . . A-Closed

Remainder of Second Creek drainage . . . . . B-D_1

Crow Creek (mainstem) from road crossing in Section 16, T20N, R20W to the Flathead River . . . . . B-D_2

Tributaries to Crow Creek from road crossing in Section 16 to the Flathead River . . . . . B-D_1

Little Bitterroot River drainage to Hubbart Reservoir . . . . . B-D_1

Little Bitterroot River (mainstem) from Hubbart Reservoir dam to the Flathead River . . . . . B-D_2

Tributaries to the Little Bitterroot River from Hubbart Reservoir to the Flathead River except Hot Springs Creek listed below . . . . . B-D_1

Hot Springs Creek drainage to the Hot Springs water supply intake . . . . . A-Closed

Hot Springs Creek (mainstem) from the Hot Springs water supply intake to the Little Bitterroot River . . . . E-F

Tributaries to Hot Springs Creek (if any) from the Hot Springs water supply intake to the Little Bitterrot River . B-D_1

Mission Creek drainage to the St. Ignatius water supply intake . A-Open-D_1

Mission Creek drainage from the St. Ignatius water supply intake to U. S. Highway No. 93 crossing about one mile west of St. Ignatius . . . . . B-D_1

Mission Creek (mainstem) from U. S. Highway No. 93 crossing to the Flathead River . . . . . B-D_2

Tributaries to Mission Creek from the U. S. Highway No. 93 crossing to the Flathead River . . . . . B-D_1

All waters outside park from park boundary to the International Boundary . . . . . B-D_1 .

(5) Water-use description and specific water quality criteria.

(a) General. Specific water quality criteria, along with criteria in section (6) protect the beneficial water uses set forth in the water-use descriptions for the following classifications of water. Criteria for organisms of the coliform group are based on a minimum of five samples obtained during separate 24-hour periods during any consecutive 30-day period analyzed by the most probable number or equivalent membrane filter methods. The metal limits on the Clark Fork River [section (6)] are to govern when this section (5) imposes a conflicting requirement with that criteria.

(b) A-Closed classification.

(i) Water-use description. Water supply for drinking, culinary and food processing purposes suitable for use after simple disinfection. Public access and activities such as livestock grazing and timber harvest are to be controlled by the utility owner under conditions prescribed and orders issued by the department. Only those waters on which access is presently controlled by the utility owner have been classified as A-Closed. If other uses are permitted, the waters are to be reclassified A-Open-D_1.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the coliform group is not to exceed 50 per 100 milliliters.

(ab) Dissolved oxygen criteria are not applicable for the classification.

(ac) No change from natural pH is allowed.

(ad) No increase above naturally occurring turbidity is allowed.

(ae) No increase above naturally occurring water temperature is allowed.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

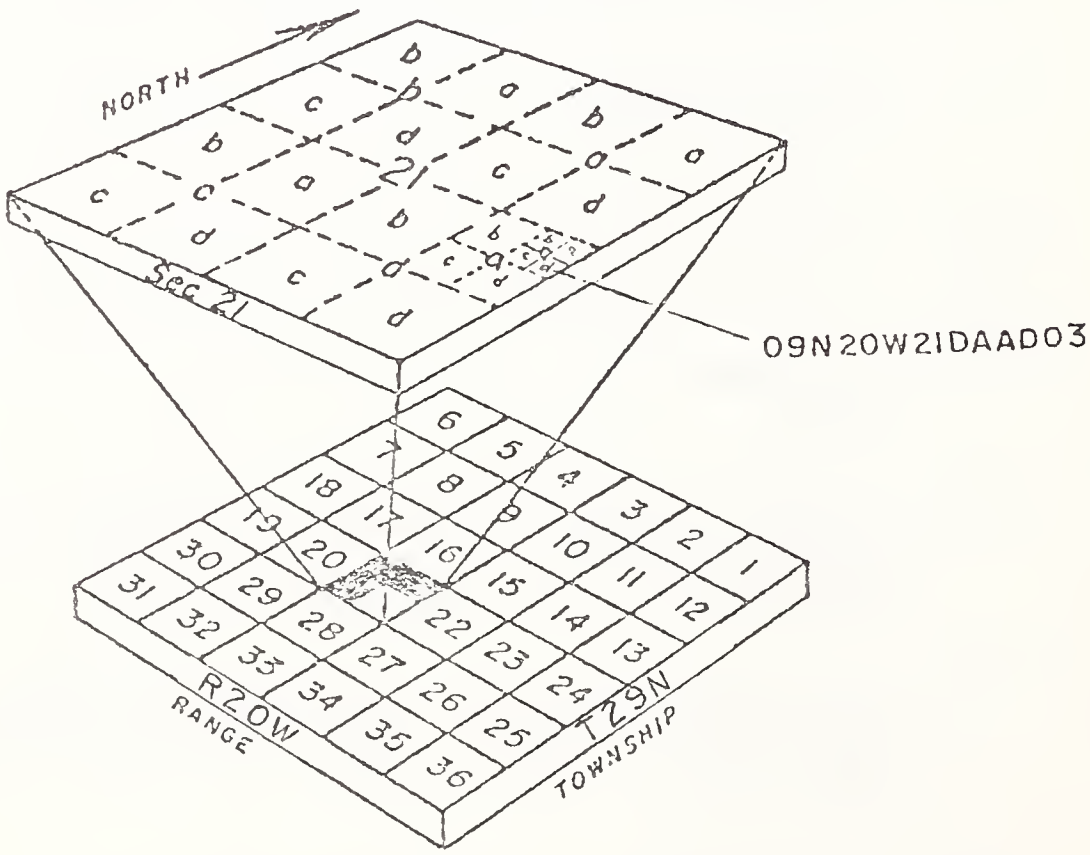
(ag) No increases of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, above naturally occurring concentrations, are allowed.

(ah) No wastes are allowed which increase radioactivity above natural background levels.

APPENDIX 3

SYSTEM FOR GEOGRAPHICAL LOCATION OF FEATURES

Features such as water sampling sites, wells, and springs are assigned a location number that is based on the system of land subdivision used by the U. S. Bureau of Land Management. The number consists of fifteen characters and describes the location by township, range, section and position within the section. The figure below illustrates this numbering method. The first three characters of the number give the township, the next three the range. The next two numbers give the section number within the township, and the next four letters describe the location within the quarter section (160-acre tract), and quarter-quarter section (40-acre tract), and a quarter-quarter-quarter section (10-acre tract), and the quarter-quarter-quarter-quarter (2 1/2-acre tract). These subdivisions of the 640-acre section are designated as A, B, C, and D in a counterclockwise direction, beginning in the northeast quadrant. If there is more than one feature in a 2 1/2-acre tract, consecutive digits beginning with the number 02 are added to the number. For example, if a water quality sample was collected in Section 21, T29N, R20W it would be numbered 29N20W21DAAD02. The letters DAAD indicate that the well is in the southeast 1/4 of the northeast 1/4 of the northeast 1/4 of the southeast 1/4, and the number 02 following the letters DAAD indicates that there is more than one site location in this 2 1/2-acre tract.



FY76 PRIORITY LIST

COMMUNITY	STREAM SEGMENT	WATER USE	POPULATION SERVED	SCOPE OF PROJECT	PHASE CONSTRUCTION	TOTAL POINTS
Three Forks	6	6	2	30	30	74
Great Falls	4	4	3	30	30	71
Butte	8	2	3	40		53
Victor	6	6	1	40		53
Miles City	6	2	2	40		50
Poplar	6	2	2	40		50
Blgs. 6th Ave. N. Int.	4	2	3	40		49
Havre East	4	2	1	40		47
Whitefish	8	6	2	30		46
Columbia Falls	8	6	2	30		46
Polson	8	6	2	30		46
Gallatin County RID 305	8	6	2	30		46
Bozeman	8	4	3	30		45
Anaconda-Opportunity	6	6	3	30		45
Bigfork	8	6	1	30		45
Livingston	6	6	2	30		44
Dillon	6	6	2	30		44
Libby	6	6	2	30		44
Hamilton	6	6	2	30		44
Red Lodge	6	6	2	30		44
Big Timber	6	6	2	30		44
Choteau	6	6	2	30		44
Townsend	6	6	2	30		44
Thompson Falls	6	6	2	30		44
Boulder	6	6	2	30		44
White Sulphur Springs	6	6	2	30		44
Eureka	6	6	2	30		44
Whitehall	6	6	2	30		44
Stevensville	6	6	1	30		43
Manhattan	6	6	1	30		43
Lodge Grass	6	6	1	30		43
Sheridan	6	6	1	30		43
Sunburst	6	6	1	30		43
Absarokee	6	6	1	30		43
Darby	6	6	1	30		43
Ennis	6	6	1	30		43
Drummond	6	6	1	30		43
East Glacier	6	6	1	30		43
Roberts	6	6	1	30		43
Hobson	6	6	1	30		43
Bearcreek	6	6	1	30		43
Lewistown	6	4	2	30		42
Laurel	6	4	2	30		42
Hardin	6	4	2	30		42
Harlowton	6	4	2	30		42

COMMUNITY	STREAM SEGMENT	WATER USE	POPULATION SERVED	SCOPE OF PROJECT	PHASE CONSTRUCTION	TOTAL POINTS
Browning	6	4	1	30		41
Chester	6	4	1	30		41
St. Ignatius	6	4	1	30		41
Hot Springs	6	4	1	30		41
Valier	6	4	1	30		41
Brady	6	4	1	30		41
Judith Gap	6	4	1	30		41
Rocker	8	2	1	30		41
Sidney	6	2	2	30		40
Wolf Point	6	2	2	30		40
Baker	6	2	2	30		40
Forsyth	6	2	2	30		40
East Helena	6	2	2	30		40
Circle	6	2	1	30		39
Big Sandy	6	2	1	30		39
Broadus	6	2	1	30		39
Ekalaka	6	2	1	30		39
Stanford	6	2	1	30		39
Denton	6	2	1	30		39
Richey	6	2	1	30		39
Gildford	6	2	1	30		39
Dodson	6	2	1	30		39
Rocky Boy	6	2	1	30		39
Deer Lodge City & Prison	2	4	2	30		38
Malta	4	2	2	30		38
Warm Springs	4	2	2	30		38
Fairfield	2	4	1	30		37
Fromberg	2	4	1	30		37
Missoula Sewers	8	6	2	15		31
Whitefish Sewers	8	6	2	15		31
Kalispell Evergreen	8	6	2	15		31
Belgrade	8	6	1	15		30
Lakeside	8	6	1	15		30
Willow Creek	8	6	1	15		30
Amsterdam-Churchill	8	6	1	15		30
Bozeman Sewers	8	4	2	15		29
Dillon Sewers	6	6	2	15		29
Plains	6	6	2	15		29
Troy	6	6	2	15		29
Livingston Sewers	6	6	1	15		28
Lolo	6	6	1	15		28
Sheridan Sewers	6	6	1	15		28
Corvallis	6	6	1	15		28
Ulm	6	6	1	15		28
Swan Lake	6	6	1	15		28
Clyde Park	6	6	1	15		28
Melrose	6	6	1	15		28
Harrison	6	6	1	15		28
Fort Shaw	6	6	1	15		28
Martinsdale	6	6	1	15		28

COMMUNITY	STREAM SEGMENT	WATER USE	POPULATION SERVED	SCOPE OF PROJECT	PHASE CONSTRUCTION	TOTAL POINTS
Great Falls Sewers	4	4	3	15		26
Butte Sewers	8	2	1	15		26
Lewistown Sewers	6	4	1	15		26
Conrad	6	4	1	15		26
St. Ignatius Sewers	6	4	1	15		26
Helena Sewers	6	2	2	15		25
Helena Valley	6	2	2	15		25
Fort Benton	6	2	2	15		25
Ashland	6	2	2	15		25
Lincoln	2	6	2	15		25
Billings Sewers	4	2	3	15		24
Miles City Sewers	6	2	1	15		24
Sidney Sewers	6	2	1	15		24
Roundup Sewers	6	2	1	15		24
Stockett	2	6	1	15		24
Simms	2	6	1	15		24
Kremlin	6	2	1	15		24
Geyser	6	2	1	15		24
Carter	6	2	1	15		24
Havre Sewers	4	2	2	15		23
Kalispell Storm Sewers	8	2	3	10		23
Billings Heights	4	2	2	15		23
Huntley	4	2	1	15		22
Gt. Fls. Storm Sewer Sep.	4	4	3	10		21
Chinook	6	2	2	10		20
Power-Teton Co. W. Assoc.	2	2	1	15		20

An acceptable application must be submitted within 90 days of notification by the Department.

APPENDIX 5

PUBLIC HEARING

Following legal advertising, a public hearing was held on May 25, 1976 at 7:00 p.m. at the Conrad Bank Building in Kalispell to receive public comment on the Flathead Basin Water Quality Management Plan. Approximately 20 persons were in attendance. The meeting was recorded in its entirety and the recording is now on file with the Water Quality Bureau in Helena, Montana. Hearing officer for the meeting was Mr. Kit Walther of the Water Quality Bureau in Helena.

Mr. Walther opened the meeting and David Nunnallee of the Kalispell office presented a 20 minute synopsis of the management plan. Following the presentation, the meeting was opened to public questions and comments from the floor.

State legislator Matt Himsl suggested that more discussion was needed of Flathead Lake proper, and that the present status of water quality in the lake should be discussed.

Mr. Robert Schumacher of the Montana Dept. of Fish and Game made several suggestions. He felt the fisheries studies which have been made in Flathead Lake by his staff should be reviewed. He also suggested that proposed areas of future study should include the effects on Flathead Lake from agricultural fertilization and groundwater monitoring (for water quantity) in the partially dewatered portions of the Stillwater and Whitefish River and Ashley Creek.

Mr. Merle Lyda, Flathead County Extension Agent, suggested that research by the Western Montana Research Center at Corvallis, Montana, could provide useful information on nitrates percolation in soils, as related to sprinkler irrigation of crop lands.

It was announced that the record would remain open for written testimony for 30 days. With that, the hearing was closed.

XV. REFERENCES

(1) U.S. Geological Survey, "Water Resources Data for Montana; Part 1. Surface Water Records", (published annually)

(2) U.S. Geological Survey, "Water Resources Data for Montana; Part 2. Water Quality Records", (published annually)

(3) Montana Department of Health & Environmental Sciences, "Montana Water Pollution Control Program Plan for Fiscal Year 1976," (June 15, 1975)

(4) Montana State Study Team, "The Flathead River Basin, A Water and Related Land Resources Study," Montana Dept. Natural Resources & Conservation & Pacific Northwest Rivers Basin Commission (in preparation, 1976)

(5) Montana State Study Team, unpublished background data developed for Flathead River Basin study (Ref. 4)

(6) Flathead Drainage 208 Project board, "Flathead Drainage 208 Project Detailed Project Plan," (May 14, 1975)

(7) Stanford, Jack A., "Ecological Studies of Plecoptera in the Upper Flathead and Tobacco Rivers, Montana," Thesis, PhD., Dept. Biology, University of Utah (Dec. 1975)

(8) Sonstelie, Lawrence C., "A Study of the Water Quality of Twelve Lakes in the Flathead Drainage Basin," Dept. Biology, Flathead Valley Community College, Kalispell, Montana (1975)

(9) Tibbs, John F., Arden R. Gaufin & Jack A. Stanford, "Distribution and Biotic Effects of Nutrients in Flathead Lake, Montana," University of Montana Biological Station, (Jan. 1975)

(10) Pacific Northwest River Basins Commission, "Comprehensive Framework Study of Water and Related Lands," 16 appendices in 22 volumes (1969-1972)

(11) Thomas, Dean & Hoskins, Consulting Engineers, "Comprehensive County Water and Sewer Plan, Flathead County, Montana," (1968)

(12) Montana Dept. Planning & Economic Development, "Comprehensive Area-Wide Water & Sewer Plan, State of Montana, Volume 1, Lincoln, Lake & Sanders Counties," (1970)

(13) Flathead County Areawide Planning Organization, "Flathead County Population Report," (June 1974)

(14) State Engineers Office, "Water Resources Survey, Flathead and Lincoln Counties, Montana," in cooperation with State Water Conservation Board and Montana State Agricultural Experiment Station, (June, 1965)

(15) State Engineers Office, "Water Resources Survey, Lake County, Montana," in cooperation with State Water Conservation Board and Montana State Agricultural Experiment Station, (June 1963)

(16) Seastedt, T.R., and John F. Tibbs, "Land Use and Water Quality in the Flathead Drainage," University of Montana Biological Station (Feb. 1974)

(17) Bauer, Ralph R., "Flathead Lake Bacteriological Study," U.S. Dept. of Interior, Federal Water Pollution Control Administration, (April 1969)

(18) Bolle, Arnold, "A Study of Policies, Guidelines, and Enforcement Procedures Affecting Prevention, Control and Abatement of Air and Water Pollution Resulting from Forestry Practices on the Flathead National Forest, Montana," University of Montana School of Forestry, (1974)

(19) Montana Dept. Health & Environmental Sciences, Water Quality Bureau, "Water Quality in Montana," (April 28, 1975)

(20) Burnett, G.W. & M.K. Botz, "Montana Water Quality Bibliography", Montana Dept. Health & Environmental Sciences, Water Quality Bureau, (1974)

(21) Turnbull & Plummer, Inc., "Facilities Planning Report for Sewage Treatment Facilities at Bigfork, Flathead County, Montana," (1975)

(22) Nunnallee, D. , T. Hall & G. Hughes, "Logan Creek Water Quality Study, Fiscal Year 1975 Report", Montana Dept. Health & Env. Sciences, (1975)

(23) Frink, J., D. Lindgren, C. Brown, J. McLeod, D. Woodworth, & M. Misner, "Review of Hungry Horse Operation as they Affect Recreation and Fish Habitat," U.S. Dept. of the Interior, Bureau of Reclamation, In-House report (Aug. 1974)

(24) Sheehan, S.W. & G.L. Ennis, "Proposed Study Flathead River," Water Quality Branch, I.W.D. (Canadian document) (Jan. 1976)

(25) Schneider, Bill, "Making Molehills Out of Mountains," Montana Outdoors, Montana Dept. Fish & Game, Vol. 5, No. 5 (Sept.-Oct. 1974)

(26) Kimble, J. Moore, Halvorson, Finley, Sloan, Stoltz & Palmer, "House Bill No. 622, An Act to Appropriate $47,500...For a Study of...The Flathead Drainage..." A bill introduced to the 44th Montana legislature (1975)

(27) Montana Dept. Health & Environmental Sciences, "Water Quality Effects of Canadian Coal Development on the North Fork Flathead River, Montana, A Proposal," Prepared for U.S. Environmental Protection Agency (Jan. 1975)

(28) Environmental Studies Division, Water Investigation Branch, Water Resources Service, "A Study of Air and Water Quality in the Kootenay Region; Phase I: Assessment of Background Information," 1st draft covering water quality in Region I; the Flathead River Basin". (Canadian document) (Nov. 1974)

(29) Rio Algom, Ltd., "Flathead Valley Coal Mine Briefing Document," prepared by B.R. Hinton & Associates, Ltd., (July, 1975)

(30) U.S. Dept. Agriculture, Forest Service,"Environmental Statement Draft, Oil & Gas Lease Applications, Exploration & Development," Flathead National Forest (June, 1975)

(31) Ahner, Mark, Technical memorandum to Flathead National Forest on Gas and Oil Lease Applications on the Flathead Forest. Flathead Co. Areawide Planning Organization (April 29, 1975)

(32) Williams, D.H., R.K. Jackson, F.K. Nunns, "Soil Survey Upper Flathead Valley Area, Montana," U.S. Dept. Agriculture, Soil Conservation Service, and Montana Agricultural Experiment Station, Series 1946, No. 4 (Sept., 1960)

(33) Johns, Willis M., "Geology and Mineral Deposits of Lincoln and Flathead Counties, Montana," Montana Bureau Mines & Geology, Bulletin 79, (Sept. 1970).

(34) Personal communication with Nelson B.C., office of British Columbia Fish & Wildlife Branch (March 1976).

(35) U.S. Dept. Agriculture, Soil Conservation Service, "Soils Survey Upper Flathead Valley Area, Montana," (Sept. 1960).

(36) Ibid, "Engineering Properties and Soil Interpretation for Use in Resource Planning & Development," (prepared as a supplement to the report of Ref. 35) (1960).

(37) Montana Dept. Health & Environmental Sciences, "Interim Project Plan for the City of Kalispell, Montana," (Dec. 9, 1971).

(38) Columbia River Water Management Group, "Columbia River Water Management Report for Water Year 1975," chart 8,(Jan. 1976).

PLATE— I

FLATHEAD RIVER BASIN

WATER QUALITY BUREAU
STATE DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

EXPLANATION

- PAVED ROADS
- UNIMPROVED ROADS
- RAILROADS
- STATE BOUNDARY
- COUNTY BOUNDARY
- PERENNIAL STREAM
- INTERMITTENT STREAM
- WATER QUALITY SAMPLING SITE
- STREAM FLOW GAGING STATION
- SEWAGE TREATMENT PLANT
- SEWAGE TREATMENT LAGOON
- WATER TREATMENT PLANT
- INDUSTRIAL WATER DISCHARGE

NOTE: THIS MAP WAS COMPILED FROM THE MONTANA STATE HIGHWAY DEPARTMENT

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